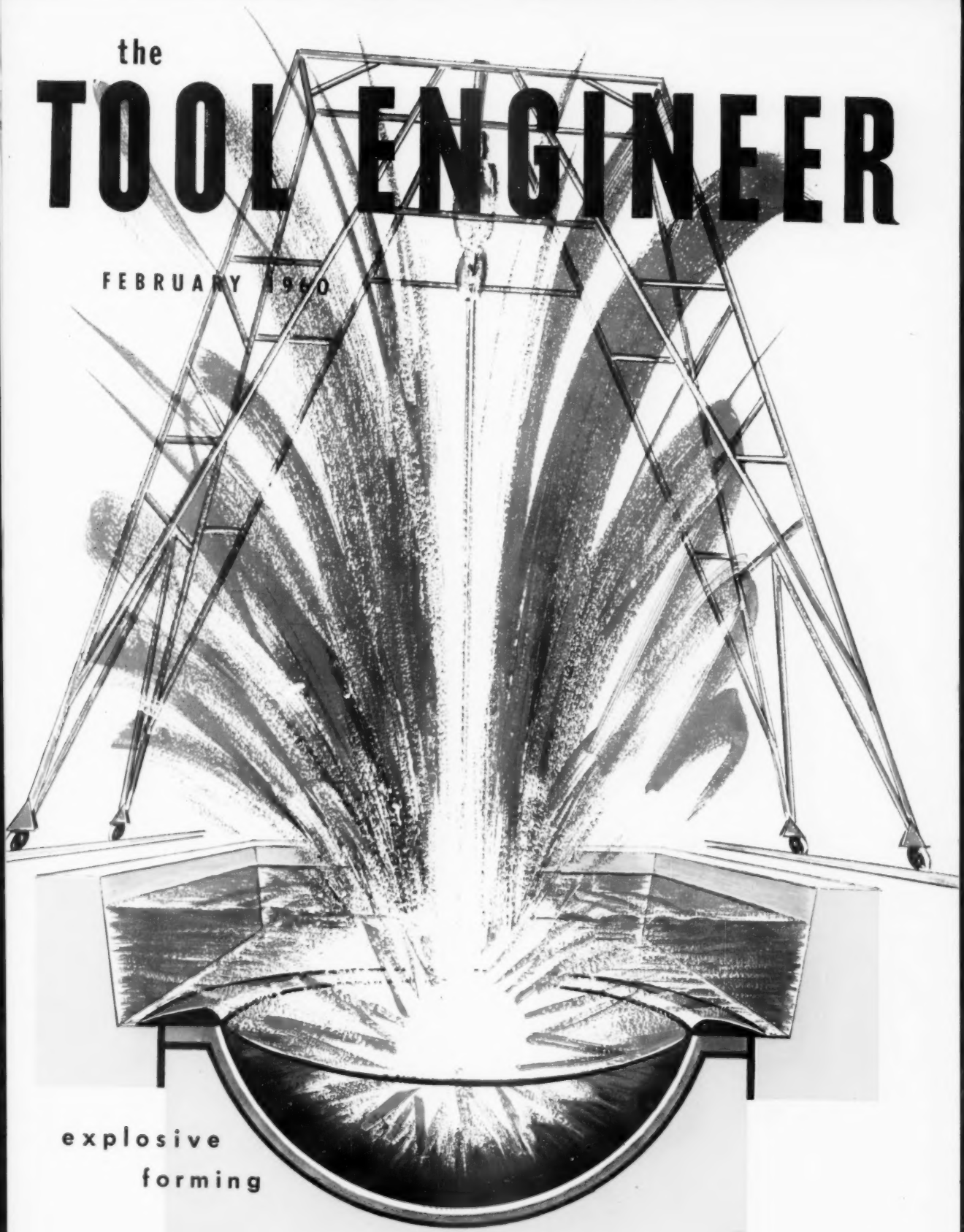
the

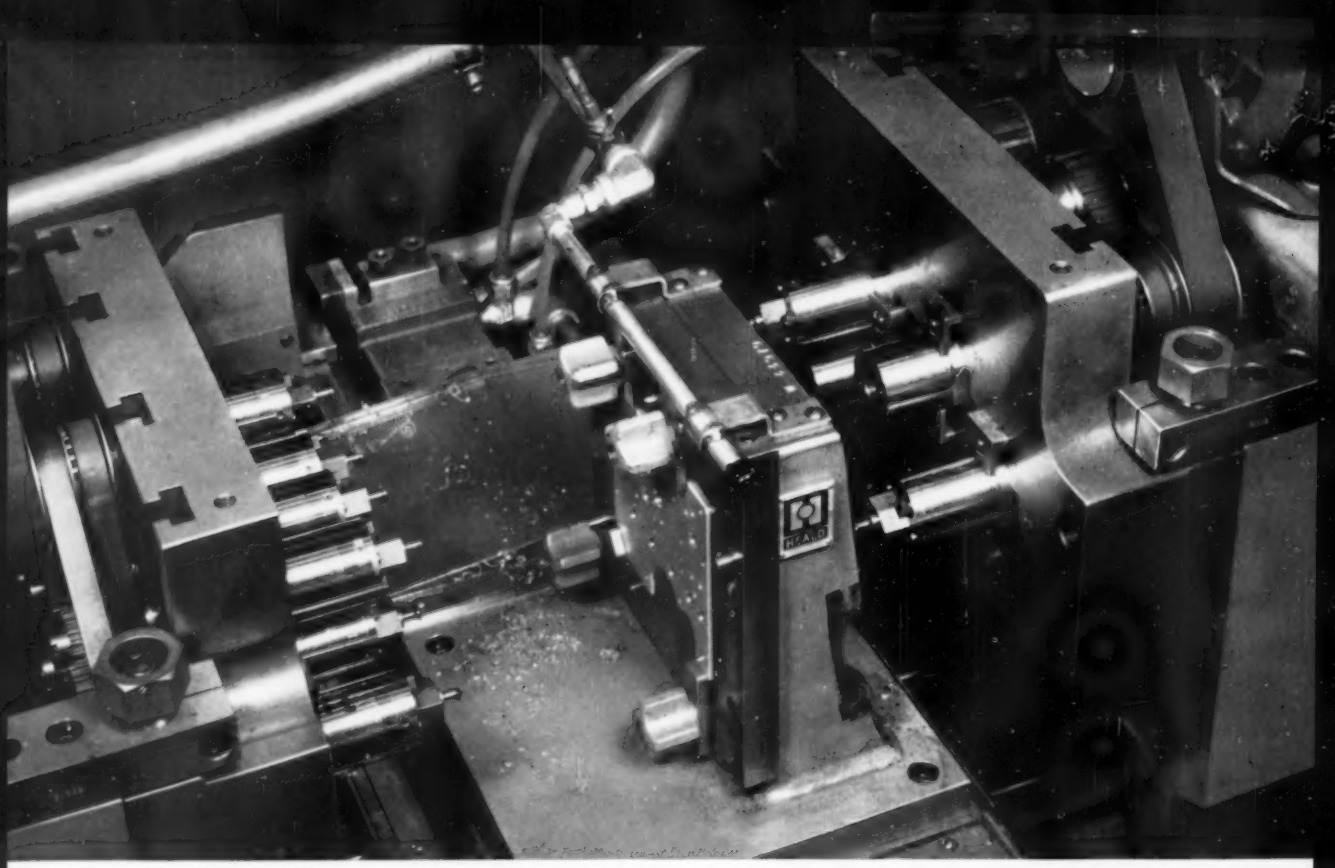
TOOL ENGINEER

FEBRUARY 1960



explosive forming

THE AMERICAN SOCIETY OF TOOL AND MANUFACTURING ENGINEERS



Bore 23 holes on 1 machine

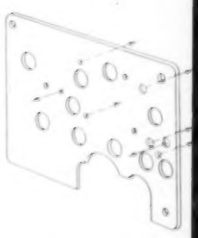
Heald Model O Bore-Matic solves multiple-hole Borizing problem with interchangeable Multi-Spindle Heads

The Problem—to precision bore 23 holes, ranging from .0365" to .3570" in diameter, in medium-hard aluminum gear-box plates, with a tolerance of .0005" on diameter and .0009" on centers—also to bore 12 similar holes in a matching plate.

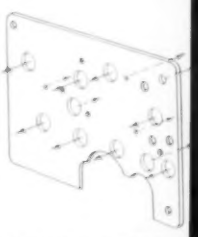
The Solution—a Heald double-end Model O Bore-Matic equipped with two sets of interchangeable Multi-Spindle boringheads. As shown in the drawings at the right, the 23-hole plate is precision Borized to the required tolerances in only three operations, using an indexing cross-slide and with all holes accurately positioned by cross-slide index and spindle location. One set of Multi-Spindle heads is used for the first two operations—then spindle plates are changed for the final operation. The second set of spindle plates also finishes all bores in the 12-hole plate in two operations. Average production is 10 parts per hour.

Heald Multi-Spindle boringheads consist of interchangeable spindle plates, precision bored to mount the desired number of miniature Red-Head boringheads which are belt-driven from a single motor. This arrangement permits simultaneous Borizing of multiple holes with center distances as close as 3/4". To save production time and cost on your multiple-hole borizing jobs, ask your Heald engineer for complete information on Model O Bore-Matics.

1. Bore two locating holes in single-end cycle using spindle plate No. 1.



2. Bore 7 holes in double-end cycle using spindle plates No. 1 and 2.



3. Replace spindle plates No. 1 and 2 with No. 3 and 4 and bore 14 holes in double-end cycle.

(Arrows show direction of table travel for holes indicated)

HEALD

MMT=pE

It PAYS to come to Heald

THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.

Worcester 6, Massachusetts

Chicago • Cleveland • Dayton • Detroit • Indianapolis • Lansing • Milwaukee • New York • Philadelphia • Syracuse

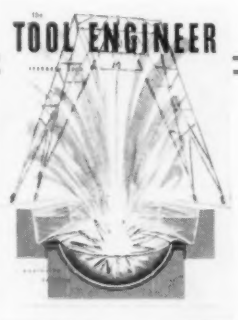
the tool engineer

Vol. 44, No. 2
February 1960

Creative Manufacturing IS TOOL ENGINEERING

THIS MONTH'S COVER

Forming of a hemispherical shell is accomplished under water. The water transmits the shock waves from an explosive charge, causing a preform to assume the shape of the die. Epoxy-faced dies have demonstrated their ability to stand up under severe conditions of this kind. Details of die design and actual production results are described in the article on page 97.



THE TOOL ENGINEER is regularly indexed in the *Engineering Index Service* and *Applied Science & Technology Index*. The magazine is available to libraries and other institutions in microfilm form.

"American" TRACER LATHES

Bulletin No. 135

gives a complete description and shows many examples. It's yours for the asking.

The Mechanical Division of General Mills, Inc. in Minneapolis, Minnesota uses "AMERICAN" Tracer Lathes for their contouring work. 17 years of ordnance and instrument work have conclusively demonstrated to the General Mills officials that only the highest quality equipment can produce the precision work that their contracts require—result "AMERICAN" selection.

More production per man hour is the answer and only answer to spiraling costs—modern, high production machinery is the answer to greater production per man hour. Judging from reports, the Mechanical Division of General Mills, Inc. has found this to be true.

THE AMERICAN TOOL WORKS CO. Cincinnati 2, Ohio, U. S. A.

LATHES AND RADIAL DRILLS

Use Reader Service Card, CIRCLE 2

Competition is Universal

Everyone seems to be concerned about our standard of living. We not only wish to maintain it at a high level but also hope to improve it. There are, however, many recent developments which should give us cause for concern. Within a few short years we have gone from a nation with all the chips to one where foreign commercial competition is shriveling up some of our markets.

To help make Europe healthy we sold machine tools and gave foreign aid. This was proper, commendable and designed for stimulating competition. Now, however, inflation and higher labor rates have put us at an economic disadvantage. Increasing productivity of the worker, resulting from automation and mass production methods, apparently has not kept pace with rising costs. Further, there are many products where craftsmanship is responsible for the major part of costs. For them, the differentials in labor rates indeed become critical.

Further evidences of increasing competition are being seen as a result of the European common market. Although partly political, it is fast becoming a commercial asset for Europe. In addition, the "Free Market" organized by England to compete with the common market will add to our problems of cost differentials.

In Detroit, during the steel strike, many automotive plants were shut down, adding to the mass unemployment. Yet department stores were crowded and record sales were rung up in the cash registers. The answer must be that people were buying on futures and mortgaging pay checks of later dates. If we are in a commercial war such may be very unhealthful.

At a recent meeting of machine tool builders, one session was devoted to discussing the subject of how best to locate a plant in Europe for manufacture. The discussions were not about how good that would be for the nation but rather how to manage the plant and how to provide economic operation. This, so that industry might have a share of the foreign market in which it cannot compete because of domestic costs. The recent steel settlement does not improve this picture.

Temporary or opportunistic measures cannot be any answer to the problems that seem to be developing throughout our industrial world. The answers must involve inventiveness and ingenuity. These we have always had. We can produce the goods if given the chance and realistic cost rates.

John W Greve

EDITOR

Buy your drills with the same care you used in buying the machine tool to run them.

STARTING POINT FOR HIGHER PRODUCTION

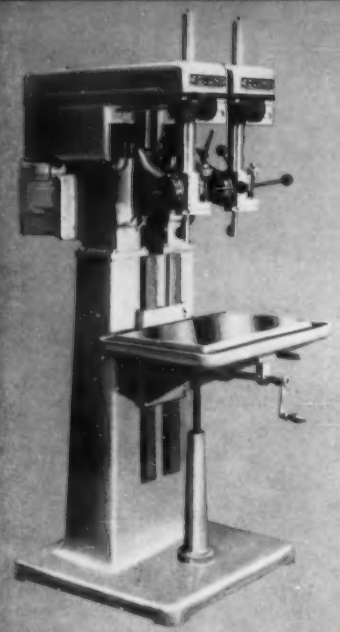
Today's production quotas demand that your machine tools deliver with all the speed and precision built into them. Equip your drilling machines with the drills that will permit them to operate with maximum efficiency and economy . . . COGSDILL . . . *the name to remember for quality . . . to watch for progress.*

COGSDILL TWIST DRILL CO., INC., Greenfield, Mass.

Stocking Warehouses:
Detroit, Los Angeles, Greenfield

EDLUND

The Greatest Advance in Drilling and Tapping Machines in the Past 25 Years



Edlund Model 1F

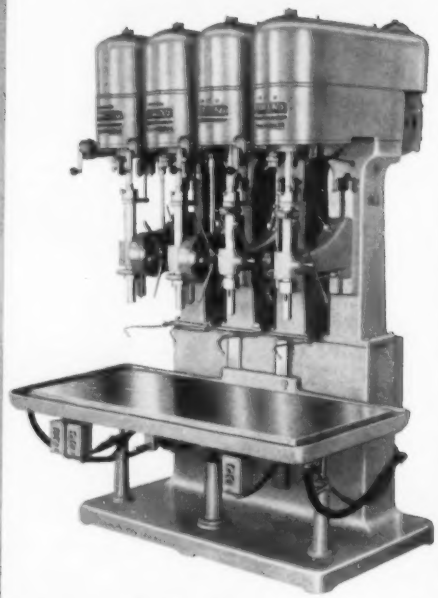
Sensitive machine for small parts and components.

Infinite selection of speeds to 10,000 rpm

7" & 10" Overhang

⅜" Capacity

Pedestal and Bench models



Edlund Model 2F

A top production machine for medium to heavy drilling and tapping.

Infinite selection of speeds to 3,600 rpm
8"–12"–15" Overhang 1¼" Capacity

Pedestal and Round Column types

Write for Bulletin 140R

EDLUND REPRESENTATIVES IN MAJOR CITIES
Use Reader Service Card, CIRCLE 5

Edlund Model 4F

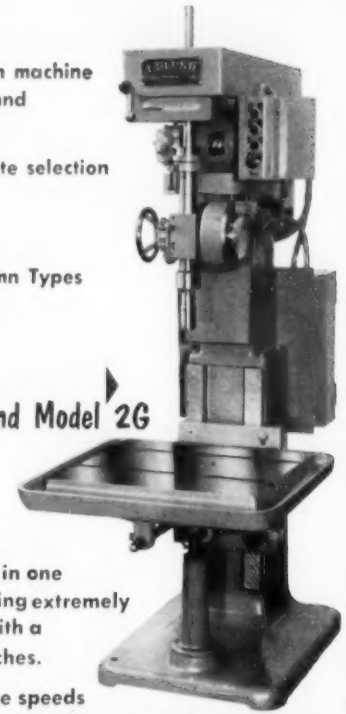
A work-horse production machine for heavy duty drilling and tapping operations.

1¾" capacity with infinite selection of speeds to 2200 rpm

12" Overhang

Pedestal or Round Column Types

Write for Bulletin 170 R



NEW! Edlund Model 2G

Vertical Gun Drilling Machine

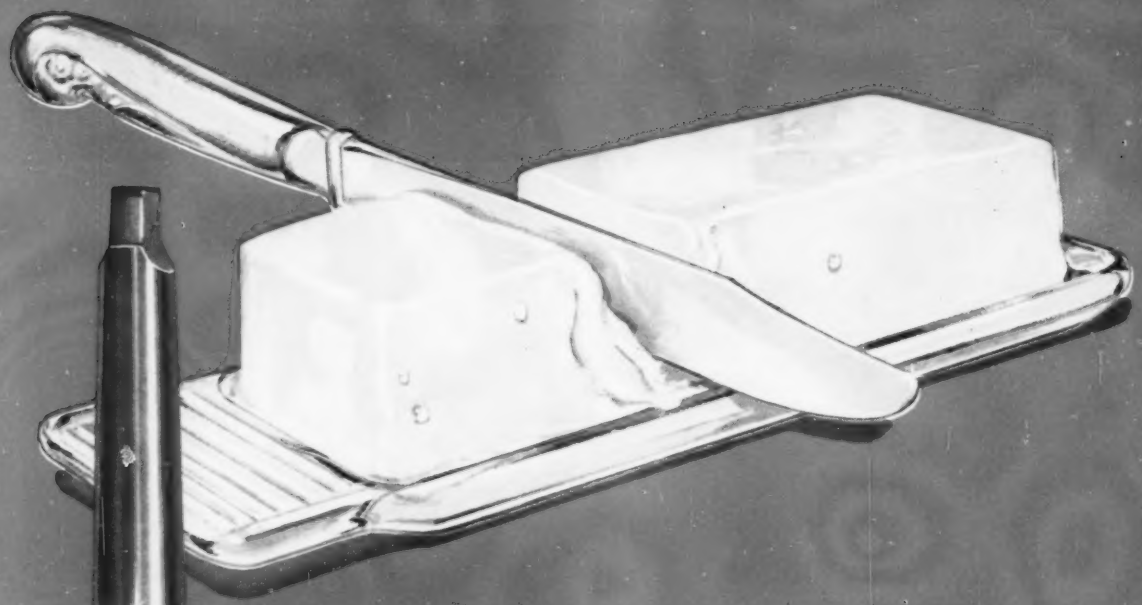
Deep hole drilling up to 7½" at production rates in one single operation producing extremely straight smooth holes with a finish from 4-8 micro-inches.

⅜" Capacity with spindle speeds to 8000 RPM 12" Overhang

Write for Bulletin 2G

Write for FREE Descriptive Bulletins

EDLUND
MACHINERY COMPANY
Cortland, New York



'like a SPEEDICUT "CHIPBREAKER" drills holes'

Running a hot knife through butter illustrates the ease and speed with which the SPEEDICUT "CHIPBREAKER" drills holes in any machinable material. The patented rib* makes possible 50% to 400% higher feed rates, uninterrupted deep hole drilling and more holes per regrind. That's how the SPEEDICUT "CHIPBREAKER" increases production, cuts drilling time and costs.

Plant-proved in more than a million miles of holes, now you can prove it yourself, in your plant, on your own equipment and type of work. Your authorized SPEEDICUT "CHIPBREAKER" distributor will gladly arrange a demonstration. Write today for brochure and name of local distributor.

*U.S. Patent Number 2769355

THE PATENTED RIB
that cannot be duplicated

SPECIFY *SPEEDICUT "CHIPBREAKER"* SPEED WITH SAFETY

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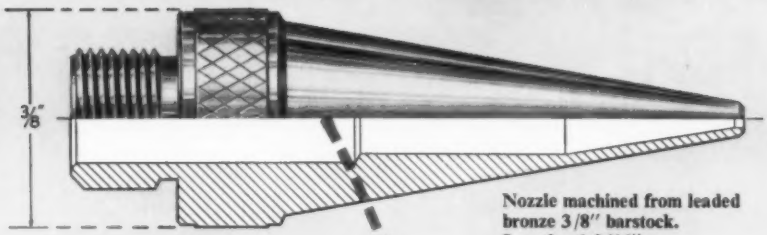
SPEEDICUT DIVISION • CHICAGO HEIGHTS STEEL CO. • CHICAGO HEIGHTS, ILL.

You Can Eliminate Costly Secondary Operations with a BECHLER SWISS AUTOMATIC



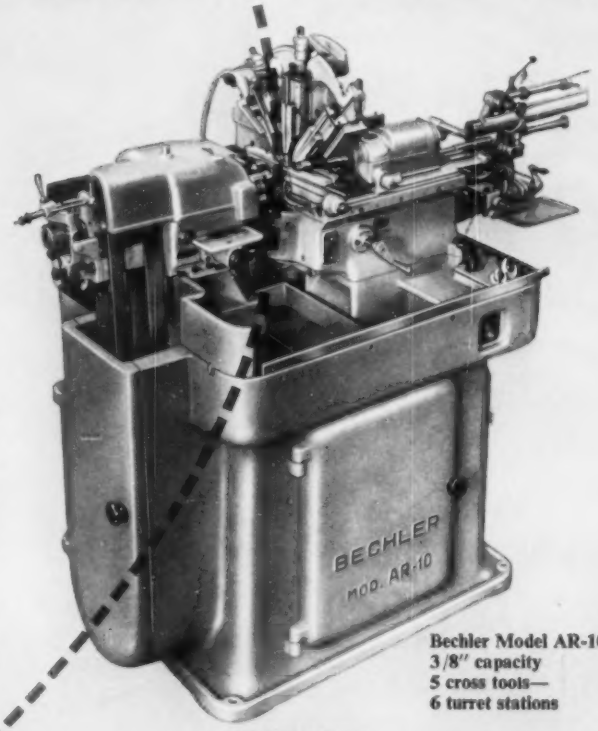
Nozzle machined from leaded bronze 3/8" barstock.
Length—1-3/16",
Thread—1/4" 40 TPI,
Large Hole—5/32".
Smallest hole—1/32" diameter.

OBTAIN COMPLETELY FINISHED PARTS IN ONE SET-UP

This Bechler AR-10, ⅜" capacity model produced this completely finished leaded bronze nozzle with 11 precise, rapidly performed operations . . . 5 slide tools generated the contour, knurled and centered. 6 turret tools machined the inside—3 straight drilling operations, rough and finish taper drilling, plus threading. All surfaces of this intricate piece are smooth, burr-free and concentric within very close tolerances. Secondary operations with chucking problems, extra handling, concentricity loss and rejects, would have cut profit to the bone.

No matter how intricate the piece, how long the production run, you can produce it better with a Bechler Swiss Automatic.

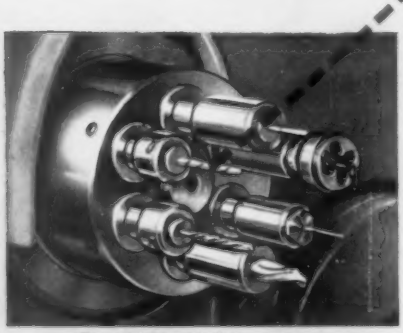
Bechler Automatic Screw Machines are available with barstock capacities up to 1¼".



Bechler Model AR-10,
3/8" capacity
5 cross tools—
6 turret stations

FEATURES

- Turret is hydraulically indexed; adjustable trip-dogs replace indexing cams.
- Turret indexing time is constant (¼ sec. on AR models) no longer depends on camshaft cycle.
- Longitudinal positioning of turret reduces approach travel of spindles.
- Many spindle combinations provide stationary and revolving drill spindles—up to 4 threading spindles.
- Optional pick-up attachment permits back drilling and slotting.
- Optional camshaft accelerator reduces idle time when cycles are relatively long.



Completely tooled drum turret.

Write for further information

BECHLER

Swiss Automatics and Allied Precision Equipment

AMERICAN BECHLER CORPORATION

28 HARBOR STREET, STAMFORD, CONNECTICUT

WHY BUY METAL YOU DON'T USE?

Switch to Allegheny Ludlum Cast-to-Shape Tools

FORGING

1250 lb. block, with 150 hours of machine time costing $1000, is necessary to fabricate die retainer.

CAST-TO-SHAPE

Cast-to-shape die retainer to hold automobile horn die weighs only 650 lbs., a $250 savings.

$1250 saved by changing to Cast-to-Shape tool steel

Paying for metal that ends up chips on the floor is a costly proposition these cost-conscious days. Here are two good reasons why you should switch your tool-making to Allegheny Ludlum cast-to-shape tools.

CAST-TO-SHAPE MEANS YOU BUY FEWER POUNDS OF METAL.
For example the manufacturer of automobile horns above saved 600 pounds of expensive alloy steel by specifying a cast-to-shape die retainer instead of fabricating it from a forged block. Result? A savings of $250, including the slight pattern cost.

CAST-TO-SHAPE MEANS LESS FINISH MACHINING.
To machine a retainer from the block above would have taken 150 hours of machine time at a cost of more than $1000. The Cast-to-Shape retainer is within ¼ to ⅜ inch of *finished* size, requiring only a *slight* roughing and finishing operation.

Allegheny Ludlum, a tool steel producer who makes cast-to-shape tools, casts them with the same precise quality control for which their tool steels is known. A full line of cast-to-shape tool steel grades is available. You'll find ones with high resistance to abrasion, compressive strengths of approximately 400,000 psi, easy machinability, hardening with almost no distortion, toughness, high red hardness, and the capacity to take a high polish.

Find out now how you can cut costs on your complex tools. Write for FC-4, a 28-page technical discussion of A-L's Forging and Casting Division with applications, pattern information, design tips, analyses, and heat treating instructions. Or call your nearest A-L tool steel warehouse or distributor.
ALLEGHENY LUDLUM STEEL CORPORATION, OLIVER BUILDING, PITTSBURGH 22, PENNA.
Write to Dept. TE-26

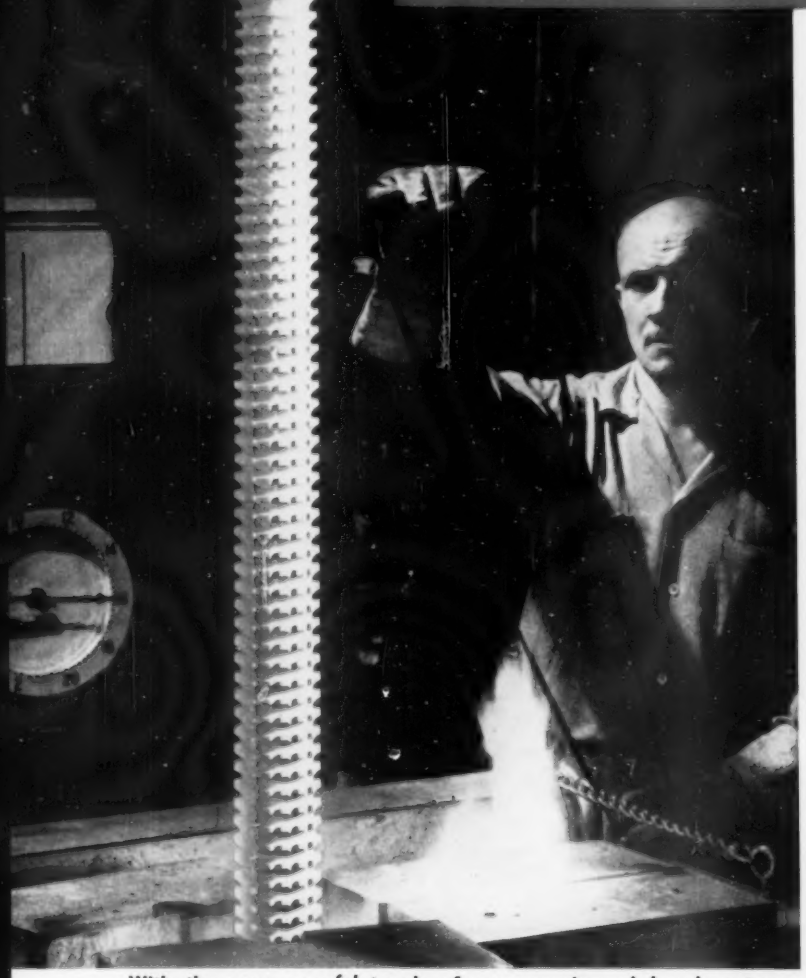
7272

ALLEGHENY LUDLUM

Tool Steel warehouse stocks throughout the country . . . Check the yellow pages

EVERY GRADE OF TOOL STEEL . . . EVERY HELP IN USING IT

CAREFUL!



With the sure, *careful* touch of an experienced hand, veteran CTW heat-treat man hoists 72" broach from a vertical furnace.

Care in the creation of Continental Broaches takes precision manufacturing a step beyond the exactness of quality control. Thirty years of broachmaking—designing and producing thousands of standard and custom-made broaches—assures *unmatched* efficiency and performance from CTW Broaches.

Find out how Continental's experience in broach engineering, modern heat treat methods and cost-saving production processes can cut downtime and increase output in your operation. Call your local Ex-Cell-O representative, or contact Ex-Cell-O Detroit; in Canada, Colonial Tool Co., Ltd., Windsor.

59-14

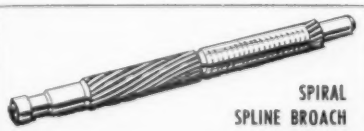
Continental CTW TOOL WORKS

DIVISION OF

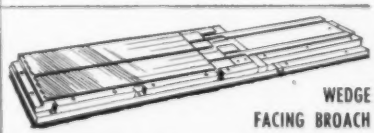
EX-CELL-O CORPORATION

DETROIT 32, MICHIGAN

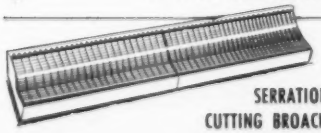
PINETREE FORM BROACH



SPIRAL SPLINE BROACH

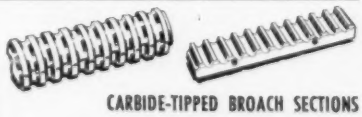


WEDGE FACING BROACH



SERRATION CUTTING BROACH

INVOLUTE SPLINE SHELL-TYPE BROACH



CARBIDE-TIPPED BROACH SECTIONS

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T. R. DREYER, Vice President—Brooklyn Manufacturing
American Machine & Foundry Company

a man who came to Fair Street

"The JIGMIL Technique enabled us to establish new manufacturing methods which provided greater accuracy, improvement in our product, substantial reductions in assembly time, and major reductions in machine time, all without investment in jigs."

"We accepted an invitation to go to Fair Street and there saw the JIGMIL Technique in operation doing boring and milling to high degrees of accuracy and economy. The potential savings in our own plant became apparent and we developed a JIGMIL program which resulted in new economies in our manufacturing methods. The inherent accuracy, power and rigidity of this machine tool, combined with its automatic positioning and ease of operation are especially adaptable to precision boring and milling operations on side frames and gear boxes. In addition to the noteworthy savings in boring time and reduced tooling cost, we gained the advantage of milling in the same setting at a minimum of cost."

T. R. DREYER

DE VLIEG MACHINE COMPANY, FAIR STREET, **ROYAL OAK, MICHIGAN**

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Beech Aircraft Corp.
Boeing Airplane Co.
Boyar-Schultz Corp.
Carrier Corp.
Clark Equipment Co.
Continental Can Co., Inc.
Convair, A Division of General Dynamics Corp.
Crankshaft Machine Co.
The DeLaval Separator Co.
Detroit Broach Co.
Douglas Aircraft Co., Inc.
Eastman Kodak Co.
Emsco Manufacturing Co.
The Falk Corp.
Foote-Burt Co.
Goss Printing Press Co.
Grumann Aircraft Engineering Corp.
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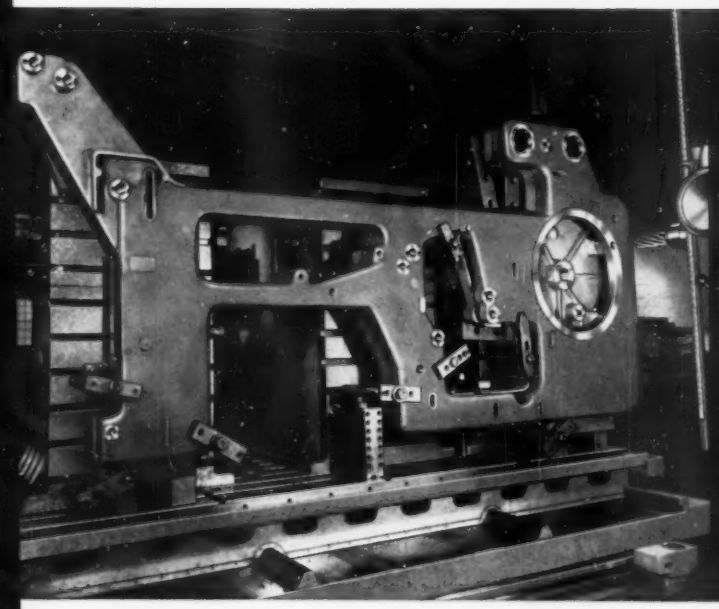


A FEW PROVEN ADVANTAGES OF THE JIGMIL TECHNIQUE—

- Eliminates cost of expensive jigs and production delays resulting from their manufacture.
- Simplifies tooling.
- Employs automatic functions to reduce factors of human error even in close tolerance work.
- Makes possible greater flexibility of product design.
- Improves end product by permitting interchangeable assembly of parts without hand fitting.
- Increases production and product accuracy.

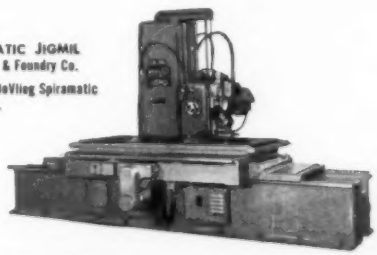
ACCURACY IS AN ECONOMY!

A TYPICAL EXAMPLE OF JIGMIL VERSATILITY

AMF uses the JIGMIL Technique for machining a multitude of components for their cigarette making machines, bread-wrapping machines, automatic pin setters, cigar making machines and many others. Illustrated is a pair of bread-wrapper side frames set against angle blocks on a Model 4B-96 SPIRAMATIC JIGMIL. All boring and side milling operations were done on the JIGMIL in one setup. Previous time on conventional boring and milling machines was 10 hours per part. Time on the JIGMIL is 3 hours per part.

The Glenn L. Martin Co.
Michigan Tool Co.
North American Aviation, Inc.
Northrop Aircraft, Inc.
Otis Elevator Co.
Pratt & Whitney Aircraft Division, United Aircraft Corp.
Solar Aircraft Co.
Speco Division, Kelsey-Hayes Co.
Thompson Products, Inc.
United Shoe Machinery Corp.
Western Electric Co., Inc.
Yale and Towne Manufacturing Co.
York Corp.

WILL YOU BE THE NEXT TO VISIT FAIR STREET



Model 4B-96 SPIRAMATIC JIGMIL as used by American Machine & Foundry Co.

For complete information on DeVlieg Spiramatic Jigmils, send for new catalog.

DeVlieg

SPIRAMATIC JIGMILS®

ACCURATE HOLES AND FLAT SURFACES IN PRECISE LOCATIONS

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precision promised ..precision delivered!

That's the story of American Drill Jig Bushings

When precision is expected, **you can depend on American!** American distributors offer a complete line of standard, off-the-shelf precision drill jig bushings **in your city.**

Let us send you our new catalog with drill bushing selection tables — making it easy for you to specify the proper bushings, for all your bushing needs.

American **DRILL BUSHING CO.**

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Made in West Germany

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SINCE 1846

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- Universal Measuring Microscope
- Large and Small Toolmaker's Microscopes
- Interference Microscope
- Light Section Microscope
- Metallurgical Microscope
- Stereo Microscope
- Epi-Technoscope
- Gauge Block Interferometer
- Circular Division Tester
- Cam Shaft Tester
- Vertical and Horizontal Metroscopes
- Large and Small Optical Dividing Heads

Ultraphot II for incident illumination with automatic exposure-setting device.
Photo Microscope for incident illumination with automatic exposure-setting device.

Write for free detailed specifications on equipment of interest to you.

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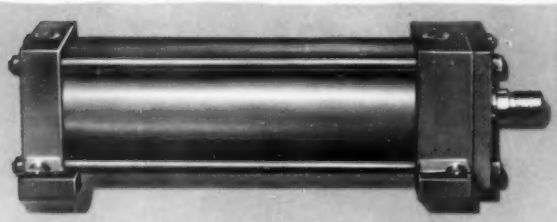
COMPLETE SERVICE FACILITIES

For literature on Hannifin items, CIRCLE No. 198
For literature on Fittings & Hose, CIRCLE No. 199



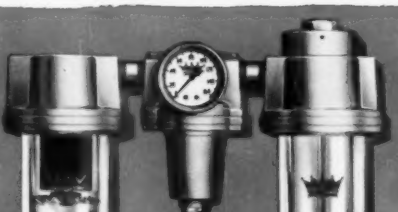
Hannifin air power cylinders, available in a full range of mounting styles, bore sizes from 1½" through 14", strokes to 20 feet. Cylinder bodies bored, then honed satin-smooth . . . for low friction, long packing life.

Hannifin's complete line of air control valves includes electric solenoid-, pressure-, cam-, hand-, and foot-actuated valves. Write for our compact new "Valve Finder."

PARKER-HANNIFIN
puts air to work without costly leaks

Now . . . complete pneumatic power systems, engineered for long leak-proof life, are available from your Parker-Hannifin man. Hannifin "Crown" units supply filtered, lubricated air at optimum pressure. Hannifin air valves shift quickly and seal bubble-tight. Hannifin air cylinders and air motors are low-friction, leak-proof. Parker "Push-lok" hose fittings and "Intru-lok" tube fittings provide quick, easy, leak-proof connections. The over-all result is more work from less air!

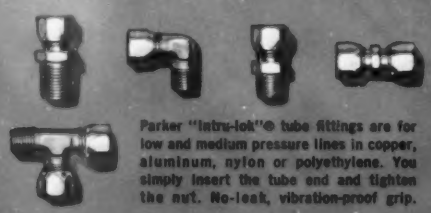
Our field engineering service helps you design your circuits and select the components. Many items are available locally, from Parker-Hannifin distributor stocks.



Hannifin "Crown" filters, regulators and lubricators—available singly or in any combination. Stocked in many cities by Parker-Hannifin distributors.

The Hannifin air motor combines a high-efficiency, leak-proof power cylinder and its electric control valve with built-in speed controls into one compact package. A single air line connection is needed, reducing installation costs.

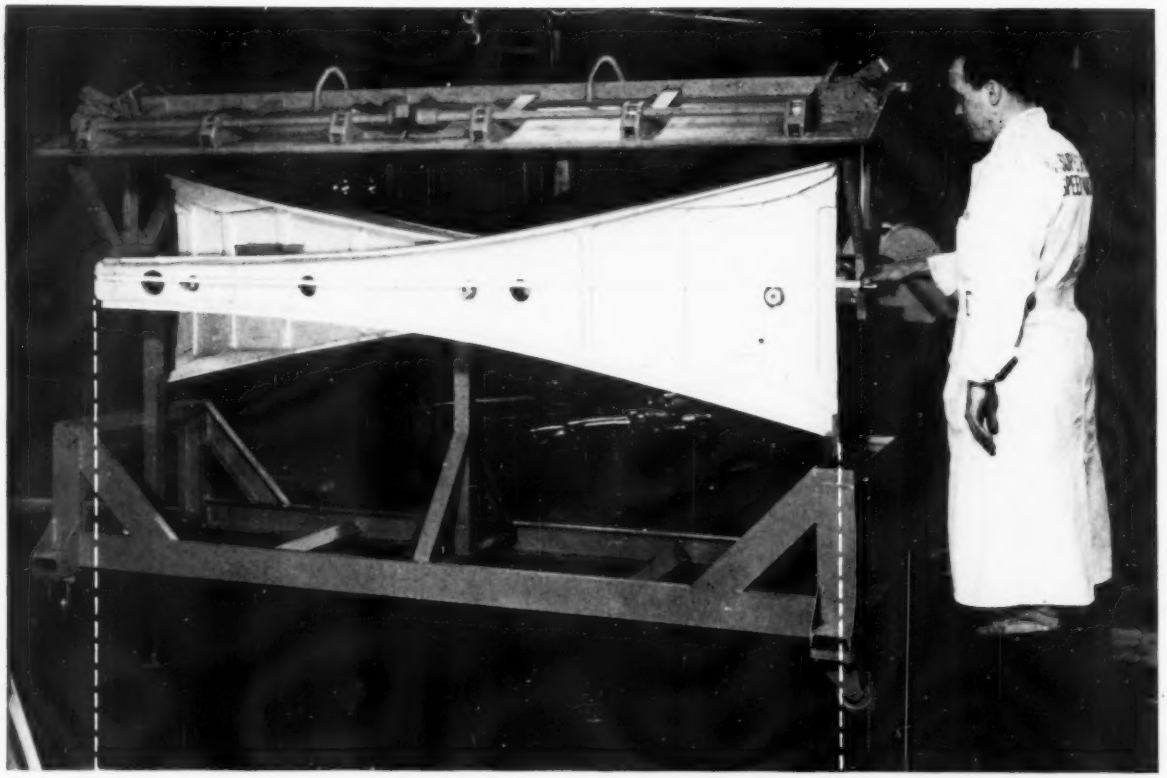
A bench-backed hand push joins Parker "Push-lok" hose fittings to Parker hose. No tools required. Won't blow off.



Parker "Intru-lok"© tube fittings are for low and medium pressure lines in copper, aluminum, nylon or polyethylene. You simply insert the tube end and tighten the nut. No-leak, vibration-proof grip.

Parker FITTINGS AND HOSE DIVISION
17325 Euclid Avenue, Cleveland 12, Ohio

HANNIFIN COMPANY
555 S. Wolf Road, Des Plaines, Illinois



Can parts this long be barrel finished?

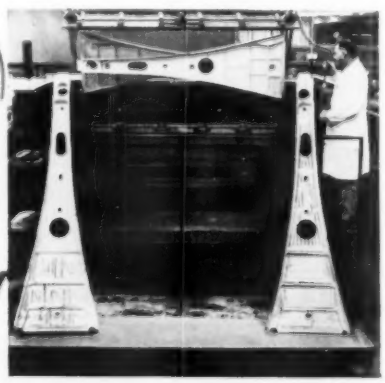
ALMCO Supersheen System — SUPERIOR MACHINES AND METHODS FOR FINER BARREL FINISHING.

YES! With ALMCO's efficient, versatile barrel finishing equipment, the 93 inch wing spar above was finished in a two hour time cycle. Thirty inches long at the wide end and 8 inches thick, the spars are finished two at a time in a special ALMCO unit at McDonnell Aircraft Corp., St. Louis, Missouri. Previous hand methods required many additional hours of finishing time and it was difficult to maintain uniformity of the parts.

These aircraft wing spars are barrel finished to blend in radii and improve micro-inch finish on other surfaces through use of ALMCO Supersheen media and burnishing compounds. All surfaces receive the same treatment—rejects due to imperfect finishing are eliminated. Tremendous labor savings are made by using ALMCO's modern barrel finishing methods.

ALMCO's modern machines and methods—the Supersheen System—may help you achieve vital costs savings too. At ALMCO you receive trained counsel for your finishing problems . . . *free* sample processing in ALMCO's modern labs . . . skilled guidance in selecting the proper standard or custom-designed ALMCO machines and methods. Write today on your letterhead asking for an ALMCO sales engineer to call. Or send parts direct to ALMCO's lab with specs required.

Note "machining ridges" on foreground spars, prior to Almco Barrel Finishing. Supersheen Aluminum Oxide chips with Almco #10 compound are used in 2 hour finishing cycle.



NEWS ABOUT ALMCO'S NEW PRODUCTS!

New brochures now ready on Almco spindle machine, Vibrasheen, other cost saving units. Price list on Almco compounds and media included. Send for your Almco Album of New Products today!

ALMCO

Queen Products Division • King-Seeley Corporation

182 E. Main St. • Albert Lea, Minnesota

Sales and Engineering Offices in Chicago, Detroit, Los Angeles, Newark, New Haven

IN ENGLAND: Almco Division of Great Britain, Ltd., Bury Mead Works, Hitchins, Herts, England

"We break every rule in the book

"We have one of the toughest testing programs in the entire industry. It breaks every safety rule that's ever been invented so that we can find out just how much punishment a grinding wheel can take.

"The test shown here, for example, is for heavy-duty snagging wheels that are used in foundries and steel mills. The wheel under test is locked into a steel drum that's built like a gun turret. Then the wheel is spun at speeds far beyond anything you can get with even the latest production equipment . . . until it finally explodes. Such tests as these have helped us formulate snagging wheels for manufacture with a *safety factor higher than ever before.*

"This, of course, is only one of the more spectacular tests we make on all Bay State wheels. There are many others that probe the ultimate strength factors of every type of wheel under extremes of heat, vibration, tension, torsion and many other variables. And the purpose of these tests goes beyond ordinary standards, too. We are not just trying to produce *acceptable* wheels. We are out to make the best wheels that can be made . . . no matter *what kind* of wheels they may be!

"The record shows that BAY STATE quality also leads to lower grinding costs. You'll find your Bay State distributor or direct representative completely equipped and thoroughly trained to analyze your grinding operations for optimum performance and minimum cost."

"Better grinding at lower cost . . . that is our business."

for YOUR SAFETY..."

Elden L. Auker, Marketing V. P. of Bay State Abrasives, is a man who knows the industry through years of experience both in working in the field with Bay State customers and from close association with the research and development programs at Bay State's manufacturing headquarters in Westboro, Mass.

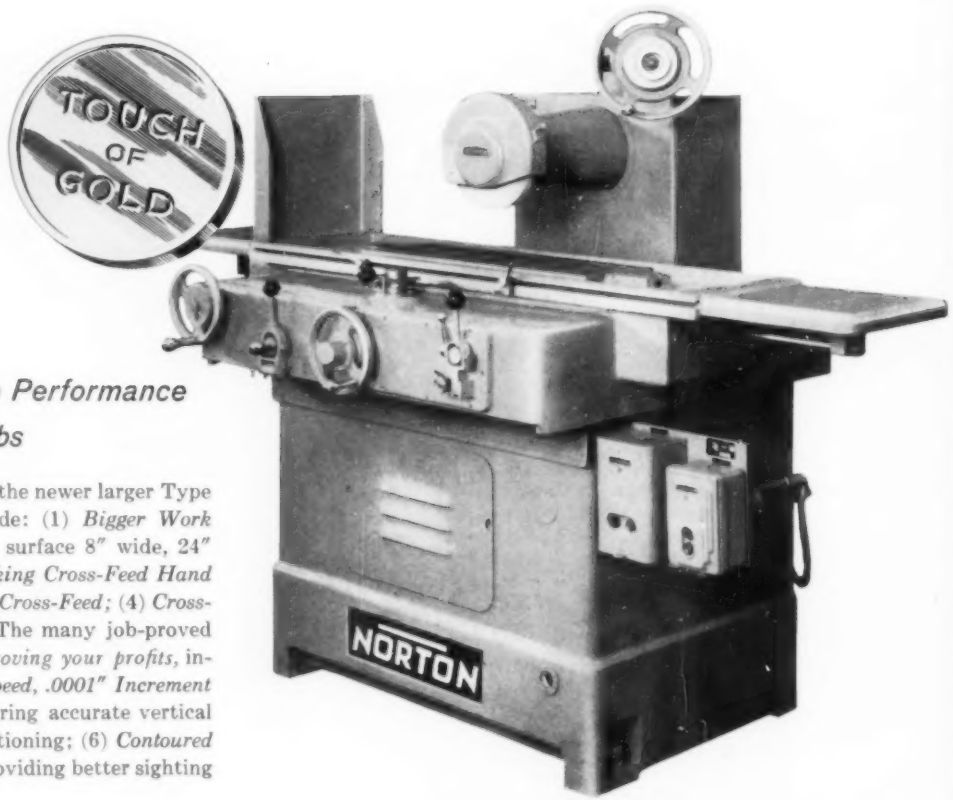
BAY STATE ABRASIVES

BAY STATE WHEELS of PROGRESS

Bay State Abrasive Products Co., Westboro, Massachusetts.
In Canada: Bay State Abrasive Products Co., (Canada) Ltd., Brantford, Ontario.
Branch Offices: Chicago, Cleveland, Detroit, Los Angeles, Pittsburgh. *Distributors:* All principal cities.

Use Reader Service Card, CIRCLE 19

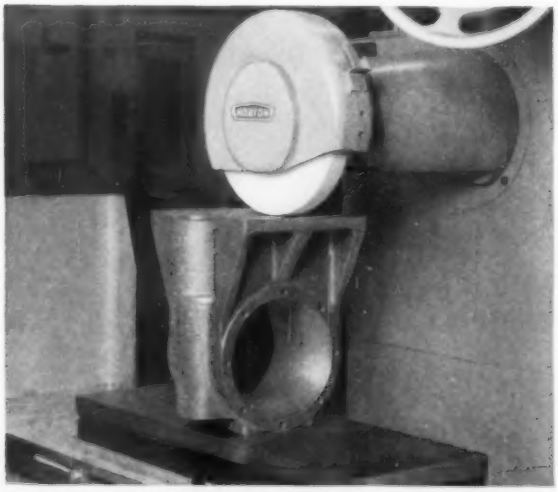
A big success...so...



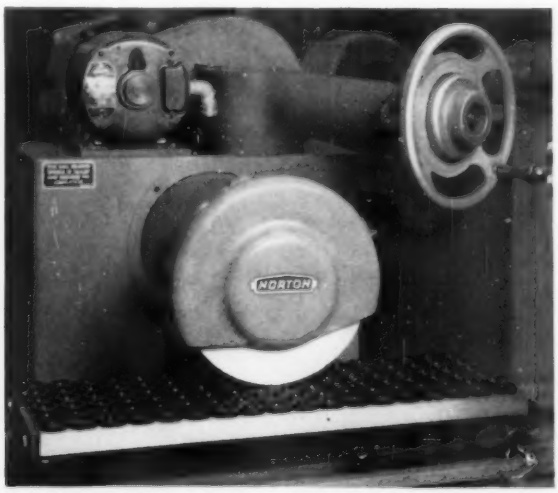
Bringing Top Performance to Larger Jobs

New additions to the newer larger Type S-3 grinder include: (1) *Bigger Work Table*, with work surface 8″ wide, 24″ long; (2) *Interlocking Cross-Feed Hand Wheel;* (3) *Power Cross-Feed;* (4) *Cross-Feed Stop Dogs.* The many job-proved features, *for improving your profits,* include: (5) *Two-Speed, .0001″ Increment Hand Wheel* assuring accurate vertical feed and fast positioning; (6) *Contoured Splash Guards* providing better sighting and loading.

NORTON PRODUCTS: Abrasives • Grinding Wheels • Machine Tools • Refractories • Electro-Chemicals — **BEHR-MANNING DIVISION:** Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes



High-Grind Wheel Head Construction, provides 13¾″ vertical capacity from table top to bottom of standard 10″ diameter grinding wheel, for handling tall workpieces.



125 Feet Per Minute is the Type S-3's high table speed that enables you to produce smoother plane surfaces, cut grinding time and increase production rate.

we're building it bigger!

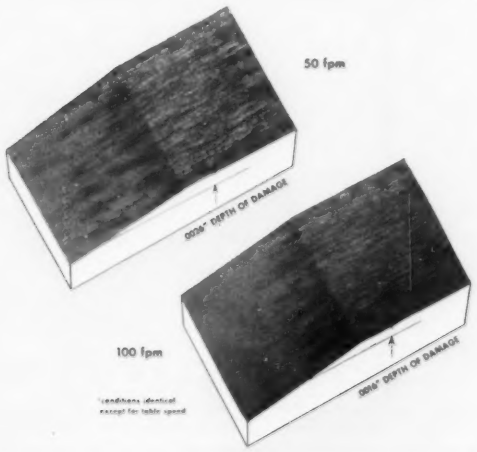
Norton Type S-3 surface grinder... with proved ability to finish flat faster... Now available in 8"x24" size

Performance of the new Norton 6" x 18" Type S-3 surface grinder for customers like these . . . Addressograph-Multigraph Corporation, Clevite Corporation, Cleveland Graphite Bronze Division, National Cash Register Company, The Timken Roller Bearing Company, Warner & Swasey Company . . . has made this larger size a necessity.

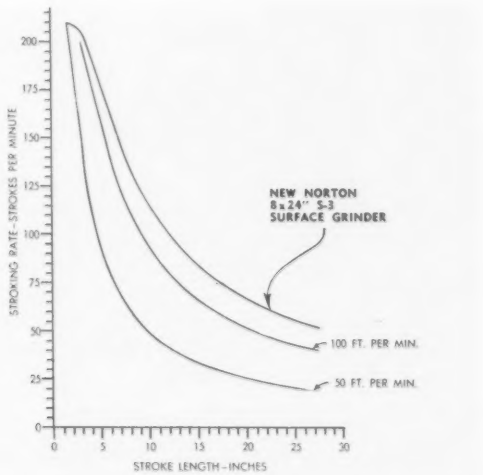
Besides a longer and wider work table, other design advancements enable this top-ranking surface grinder to finish bigger workpieces smoother, faster, at lower cost. Get the whole story from your Norton Sales Engineer, a trained specialist who can help you get better grinds for less money, or ask for our catalog 1982. NORTON COMPANY, Machine Tool Division, Worcester 6, Mass. District Offices: Worcester, Hartford, Cleveland, Chicago, Detroit. *In Canada:* J. H. Ryder Machinery Co., Ltd., Toronto 5.

NORTON
MACHINE TOOLS
75 years of... Making better products ...to make your products better

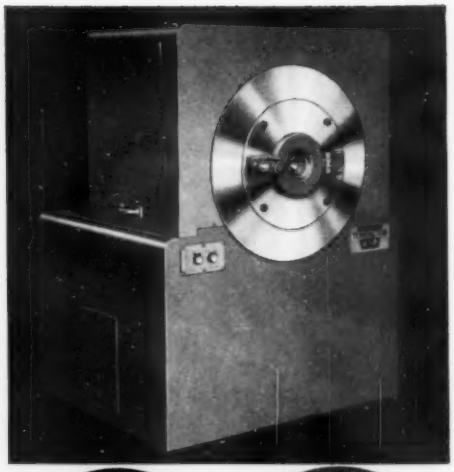
MACHINE TOOL DIVISION: Grinding and Lapping Machines — G & E DIVISION: Shapers • Gear Cutting Machines • Gear Induction Hardeners



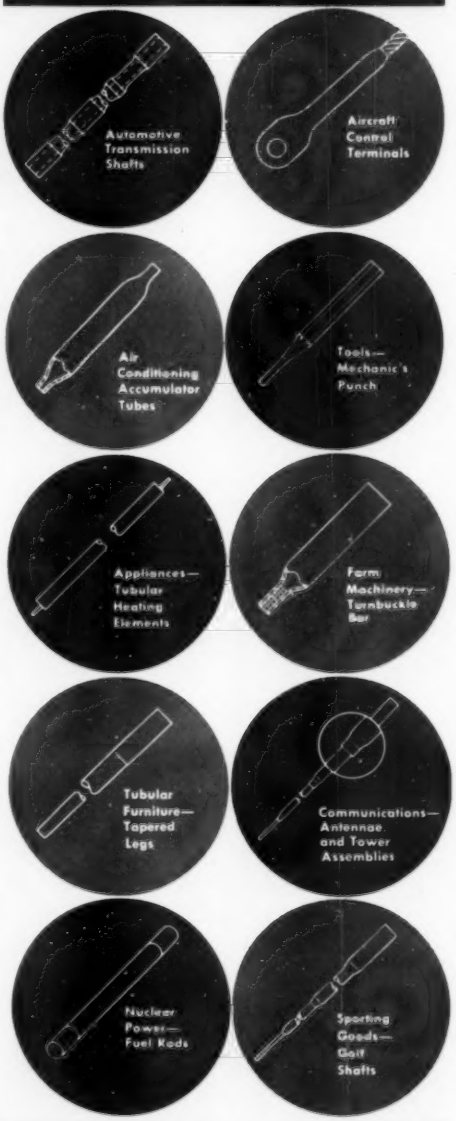
Better Quality Work due to less heat damage with faster table speeds . . . at the same time greatly increasing the rate of stock removal.



Calculate Your Savings from this Production Rate Chart. Grinding time is reduced in proportion to the increase in stroking rate.



WHAT TORRINGTON ROTARY SWAGING MACHINES CAN DO FOR YOU



These versatile, efficient machines shape metal parts by hammering between dies instead of cutting stock away. They give you a full pound of parts from every pound of metal. They also save you time and labor. Swaging is usually the fastest way to point, taper, reduce or bond metal parts. Tooling is simple and surprisingly inexpensive.

There is no greater authority on swaging than Torrington. Torrington pioneered the swaging process, designed the original equipment and has constantly improved it through innovations in methods and engineering. Today, Torrington operates more swaging machines than any other company in the world. The experience of our engineers is unparalleled. We maintain experimental shops to help you solve your special swaging problems. If you have a part that can be swaged we can design and produce "Job-Tested" dies to your specifications. Come to Torrington with your swaging problems—we have the answers. The Torrington Company, Swaging Machine Division, 444 North St., Torrington, Conn.

TORRINGTON ROTARY SWAGING

SWAGING HEADQUARTERS, U.S.A.

A PRODUCT OF SKILL

the complete line Butterfield drills are produced with skill and delivered with speed, like all other Butterfield tools: taps, reamers, dies, counterbores, cutters, end mills, hobs and carbide tools. Phone for these, or for technical aid. Warehouses in Chicago, Detroit, Fort Worth, Los Angeles, New York and San Francisco. **Call your Butterfield Distributor.**

BUTTERFIELD

DIVISION, Union Twist Drill Company, Derby Line, Vt.

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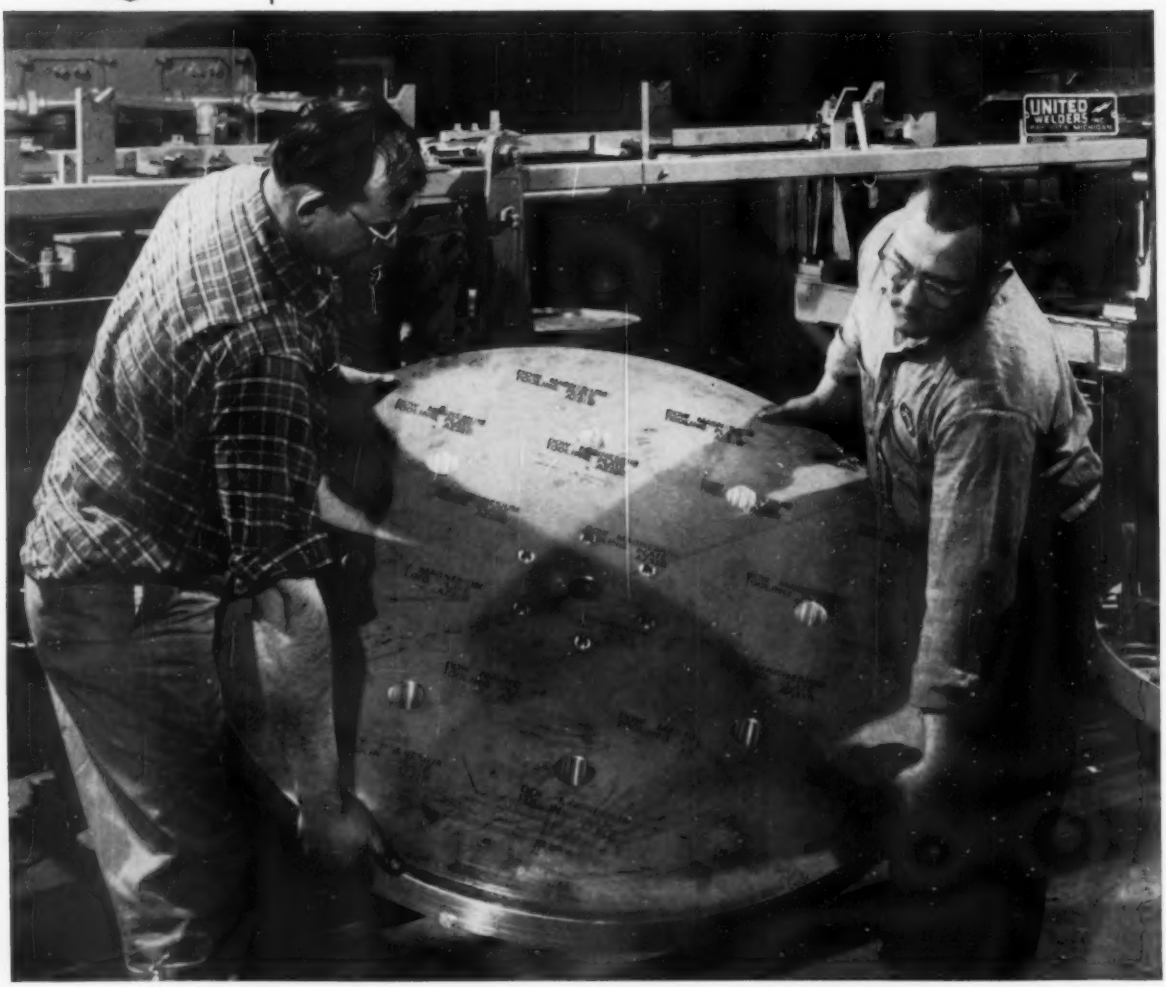
DOW | NOW IN MAGNESIUM AND ALUMINUM

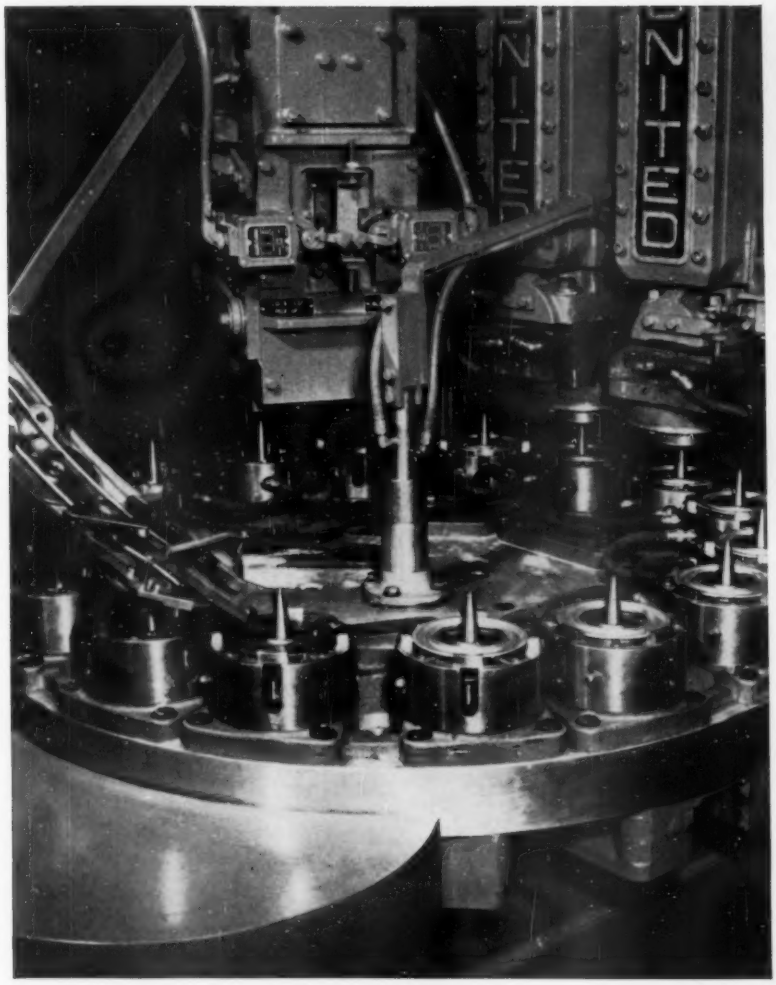


10¢ PHONE CALL CUT MACHINING TIME 50% ON 3-FT. INDEX TABLE!

Ordered-by-phone magnesium tooling plate disc replaced cast steel index table for machinery manufacturer . . . "as purchased" flatness cut previous machining time on this part in half . . . saved 50% on machining costs.

United Welders Inc., of Bay City, Michigan, recently replaced steel with magnesium tooling plate in making the precision index table, or dial, for their automatic 8 Station Dual Dial Welder. This machine is used in welding the bottom gasket retainer for an oil filter assembly in 1960 automobiles.

The dials previously were made of cast steel which required costly, time-consuming surface and edge machining to finish. The 2½ inch by 36 inch dials of magnesium tooling plate are now purchased rough-cut to size from the local Dow magnesium distributor, and are finished by simply edge truing and drilling. Because the as-purchased flatness completely eliminates need for surface machining, United's machining costs on this part have been cut by more than half. Production has been speeded, too, because magnesium's light weight makes the dials easy to handle during manufacture. Two men can easily lift and handle the light disc. Cranes or lift trucks aren't needed as they were with the previous steel dials.



Because magnesium tooling plate is uniformly flat, it can be used for almost all tooling jobs without surface machining. It's rolled and thermal flattened to close flatness tolerances . . . high dimensional stability keeps it flat in use.

MAGNESIUM TOOLING PLATE IS AVAILABLE FROM STOCK AT:

E. F. Bailey Company
Seattle, Washington

Clendenin Bros., Inc.
Baltimore, Maryland

Copper and Brass Sales, Inc.
Cleveland, Ohio; Detroit 12, Michigan

Fullerton Steel and Wire Company
Chicago 35, Illinois

Hubbell Metals Inc.
St. Louis 3, Mo.; Kansas City, Mo.; Marietta, Ga.

A. R. Purdy Co., Inc.
Lyndhurst, New Jersey

Reliance Magnesium Company
Los Angeles 58, California

Joseph T. Ryerson & Son, Inc.
Dallas, Texas

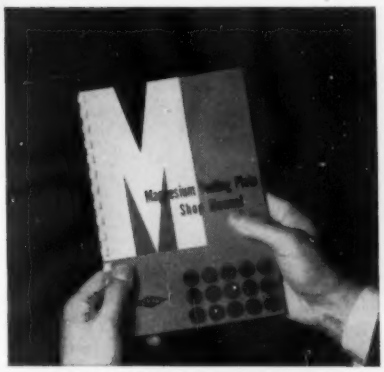
LIGHTNESS CUTS POWER NEEDS 75%

In the United welder above, the dial starts and stops 500 times per hour during welding operations. This lightweight magnesium dial requires only a quarter of the power needed to operate the previous steel dial. It permits a drastic reduction in the cost and size of motor, speed reducer and other necessary driving elements.

RIGIDITY MEANS ACCURATE POSITIONING

United Welders employs a Geneva Stop Movement to position parts accurately under dual automatic spot welding heads. Magnesium's rigidity helps the dial retain close tolerances necessary for continued accuracy.

Magnesium tooling plate has other advantages, too. It costs less to buy than other lightweight tooling materials and can easily be welded. It can often be obtained ready-cut-to-shape from distributors, saving additional time in your shop.



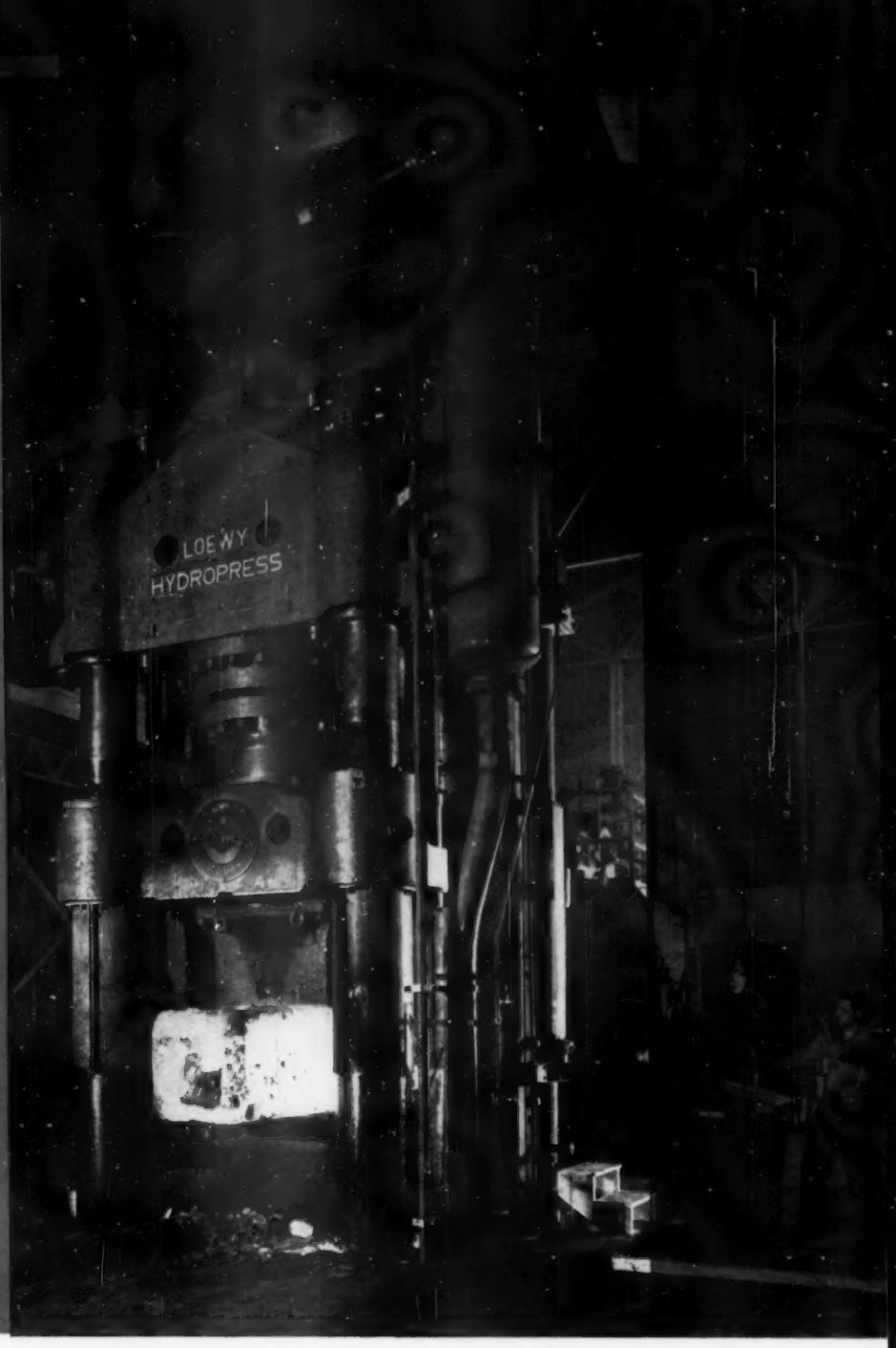
There's a wealth of information in Dow's new magnesium tooling plate manual. This handy 56-page book is filled with facts about shop working characteristics, machining, etc. For a copy, contact your Dow branch office or write to THE DOW METAL PRODUCTS COMPANY, Midland, Michigan, Merchandising Dept. 1033FJ2.

THE DOW METAL PRODUCTS COMPANY, Midland, Michigan
DIVISION OF THE DOW CHEMICAL COMPANY


(ACTION MEMO)
Joe
Look at these...
formed from WIRE!
on National Cold Formers
and Headers (like bolts
and nuts)
Fast, fully automatic
and practically scrapless
production!
Let's take our longest-run
jobs to Tiffin and learn
what their latest design
machines and methods can do
for us! OK? Bill
Founded 1874—DESIGNERS and BUILDERS of MODERN FORGING MACHINES • MAXIPRESSES • REDUCEROLLS • COLD HEADERS BOLTMAKERS • NUT FORMERS • TAPPERS • NAILMAKERS CO-PIONEERS WITH INDUSTRY OF ADVANCED METALWORKING PRODUCTION METHODS
HARTFORD DETROIT CHICAGO
NATIONAL MACHINERY CO.
TIFFIN, OHIO, U. S. A.

new press capacity

for larger steel sections



CAPACITY	2000 Tons
WORKING PRESSURE	4250 psi
STROKE	48"
DAYLIGHT	108"
COLUMN CENTERS	
(left to right)	90"
(front to back)	52"

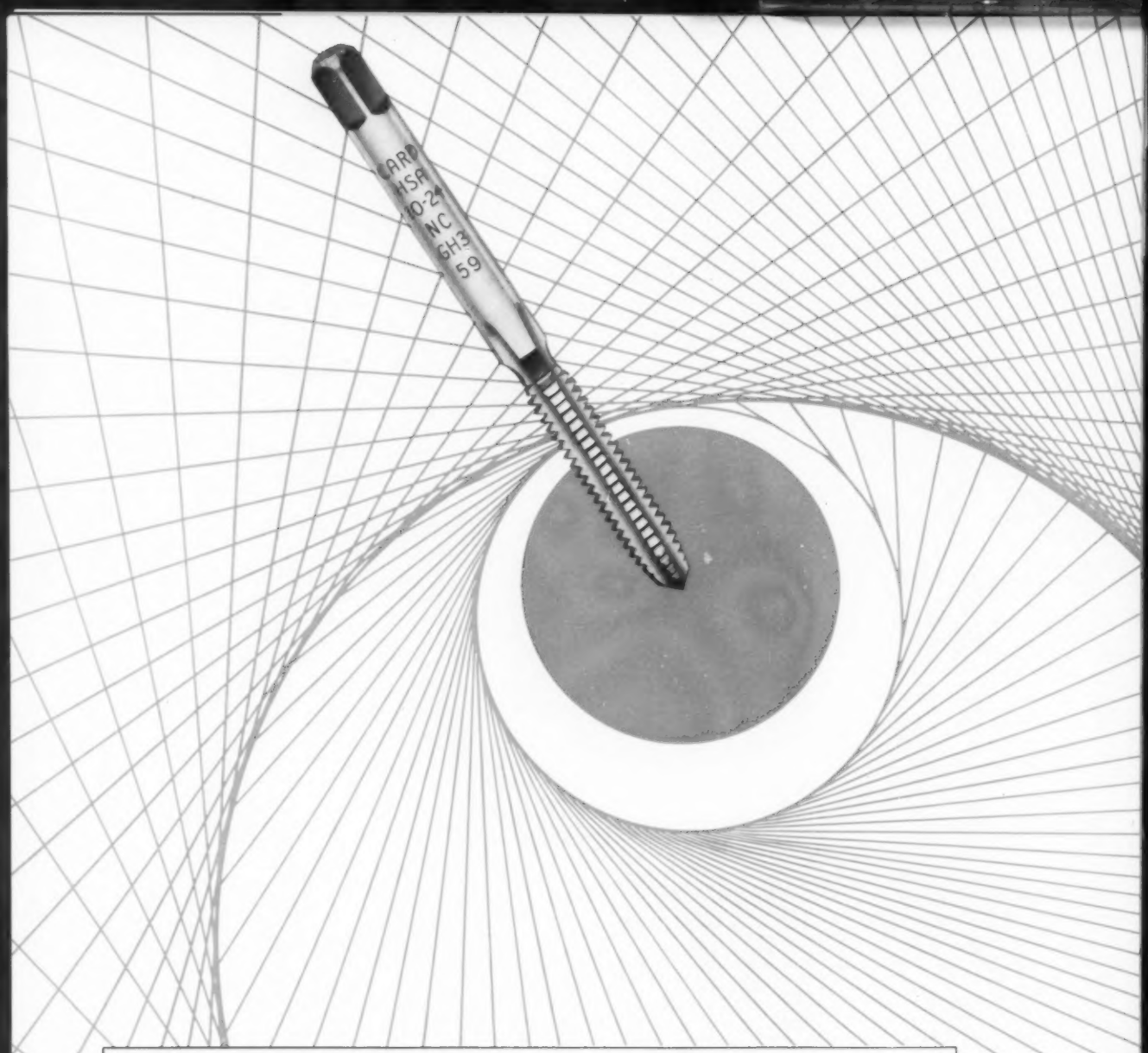
serving better production of our first quality tool steels

(and our customers' special forging needs)

2000 tons of new Vanadium-Alloys Steel press capacity is here at work—speeding delivery of more uniform large forgings in our regular production, and ready to meet special custom forging demands. Ingots from 12" square to 40" square are regularly worked. Let us quote on your block, disc and special forging requirements in First Quality tool steel grades.

Vanadium-Alloys Steel Company
LATROBE, PENNSYLVANIA

DIVISIONS: Anchor Drawn Steel Co. • Colonial Steel Co. • Metal Forming Corporation • Pittsburgh Tool Steel Wire Co.
SUBSIDIARIES: Vanadium-Alloys Steel Canada Limited • Vanadium-Alloys Steel Societa Italiana Per Azioni • EUROPEAN ASSOCIATES: Societe Commentryenne Des Aciers Fins Vanadium-Alloys (France) • Nazionale Cogne Societa Italiana (Italy)



CALCULATED TO CUT COSTS

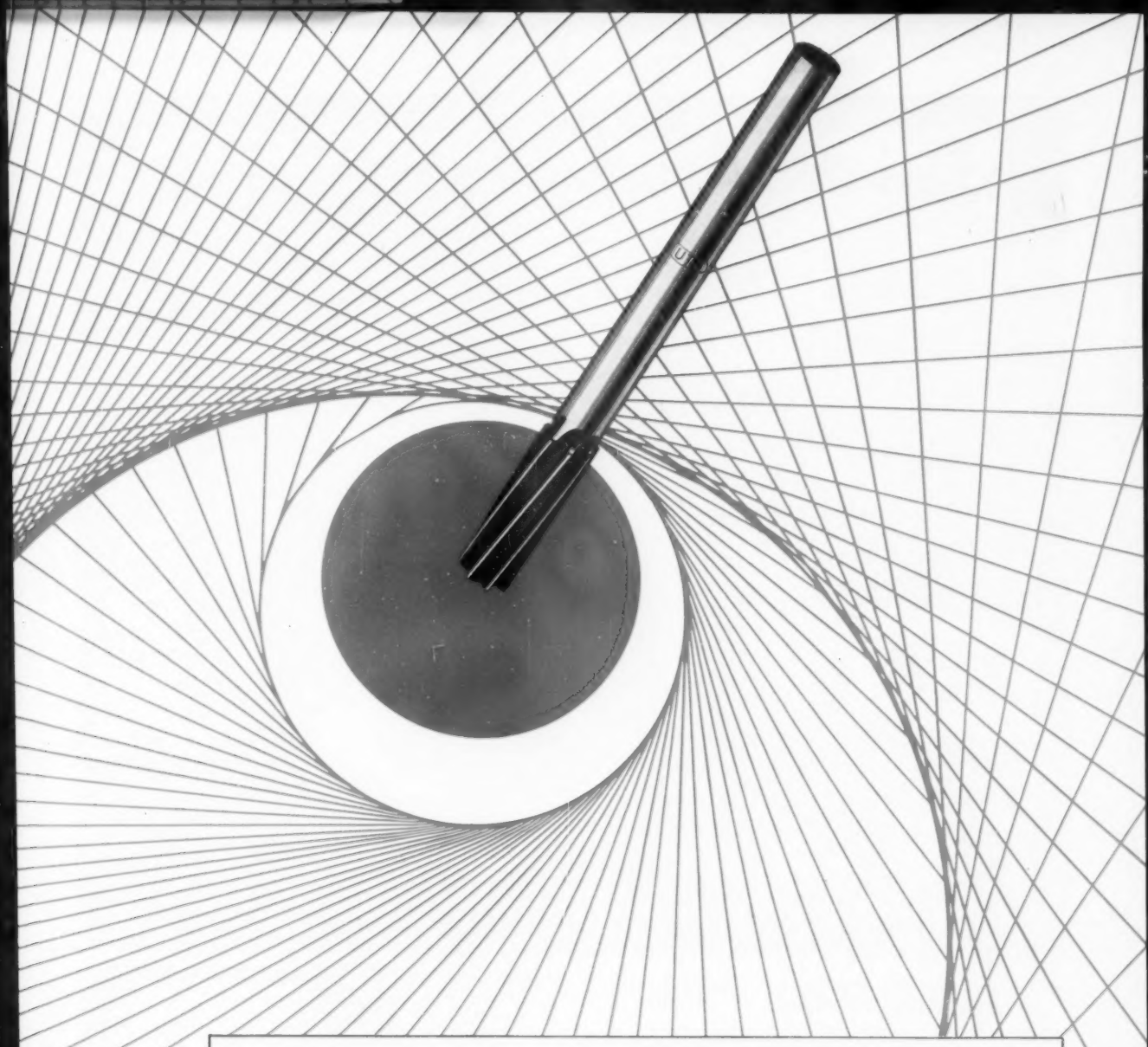
Each CARD tap of same type and size is precisely, geometrically duplicated, bringing valuable production benefits to every user. For more dependable performance, longer service life, specify CARD taps. See your CARD Distributor for all types of taps, dies, gages and screw plates. Call in your CARD technical man for valuable aid in selection and use. S. W. CARD DIVISION, Mansfield, Mass. Card Warehouses: Atlanta, Chicago, Detroit, Fort Worth, Los Angeles, New York, San Francisco.

CARD

DIVISION OF UNION TWIST DRILL COMPANY

Serving you through the best distributors from coast to coast

Use Reader Service Card, CIRCLE 28



GEOMETRIC PROGRESSION SYMBOLIZES PRECISE DUPLICATION

CALCULATED TO CUT COSTS

UNION cutting tools are duplicated with the accuracy of geometric progression. For example, all UNION reamers of the same size and type are identical with each other. Precise duplication like this can help you save production time and money. Specify UNION reamers, drills, milling cutters, end mills, gear cutters, hobs, carbide tools, and inserted blade cutters. Available nationally through UNION Distributors and stocked in UNION warehouses in Atlanta, Chicago, Detroit, Fort Worth, Los Angeles, New York City, and San Francisco. UTD

UNION

UNION TWIST DRILL COMPANY, Athol, Massachusetts

S. W. Card Division, Mansfield, Mass. Butterfield Division, Derby Line, Vt.

36.0.7

Use Reader Service Card, CIRCLE 29

STRIPPIT SUPER 30 FABRICATOR

Larger work sizes for more efficiency...for short run punching — 30" x any length ... for production run hole duplication — 25" x 30".

Adjustable table for greater accuracy and flexibility...for punching to closer tolerances in angles, shapes and formed parts as well as flat sheets.

New, no-jam electric head eliminates down time...and the need for pressurized air. Fewer parts minimize maintenance — ensure quieter, more positive operation.

Wide range of hole punching capacities...from a 3½" hole (round or shaped) in 16 gauge to a ½" hole in ¼" mild steel.

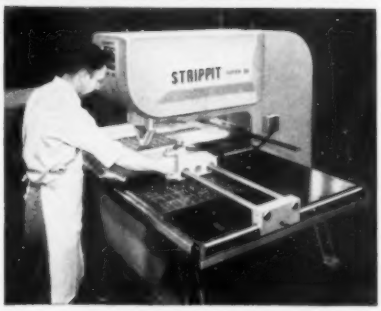
Corner and edge notching...up to 5" x 5" in 16 gauge mild steel — 90° corners, rectangular, vee, radii and special shape edge notches.

Straight line nibbling and contour shearing...at 165-strokes per minute in ⅛" mild steel. Instant changeover from single stroke punching.

New swing-shift punch holders...quick-opening, positive-closing — for right or left-hand operation. Electrical interlock for safety.

Exclusive quick-change tooling system...using standard stock punch and stripping guide assemblies and die buttons. Size changes take less than 20 seconds.

New quick-set gauging system...with micrometer settings for fast, accurate layout and rapid work positioning.



EASY CONVERSION TO A PRODUCTION PUNCHING UNIT...

with the Strippit Duplicator which can be built-in as an integral part of the Super 30 Fabricator — and the Dupl-O-Scope for punching Duplicator templates from a drawing, layout or sample part.

WRITE TODAY... for complete details, illustrated literature, price and delivery.

UNIT OF HOUDAILLE INDUSTRIES, INC. WALES

STRIPPIT INC.

211 Buell Road, Akron, New York

In Canada: Strippit Tool & Machine Company, Brampton, Ont.

NOW

FROM SPIRAL CARBIDE TOOL COMPANY

A MAJOR BREAKTHROUGH IN CUTTING TOOL MANUFACTURE* THAT SLASHES THE COST OF CARBIDE-TIPPED TOOLS

NOW

. . . Straight fluted and true spiral carbide-tipped tools are available at prices that obsolete the use of their solid steel counterparts on a replacement cost basis.

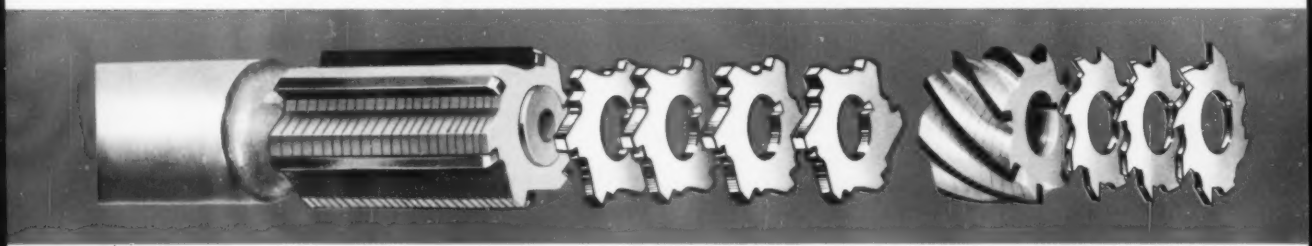
NOW

. . . Replacement costs of all carbide-tipped tools cut from 20% to 50%. Most tools formerly scrapped can now be economically salvaged.

WHAT IS THIS NEW MANUFACTURING PROCESS THAT ALLOWS THESE UNHEARD OF SAVINGS?

A pre-formed wafer fabricating method that eliminates the use of bar stock and costly cut-off, turning and milling operations used in machining multiple point cutting tools.

FOR STRAIGHT FLUTED OR TRUE SPIRAL CARBIDE-TIPPED TOOLS



Pre-formed wafers of any size and flute construction are assembled on an arbor to any desired cutting length. Carbide tips inserted in flute cut-outs. Entire assembly solidly brazed.

NOW

PRODUCTION TESTED AND FULLY GUARANTEED

*PATENT PENDING

HOW DOES THE USER BENEFIT FROM THIS NEW CUTTING TOOL MANUFACTURING PROCESS?

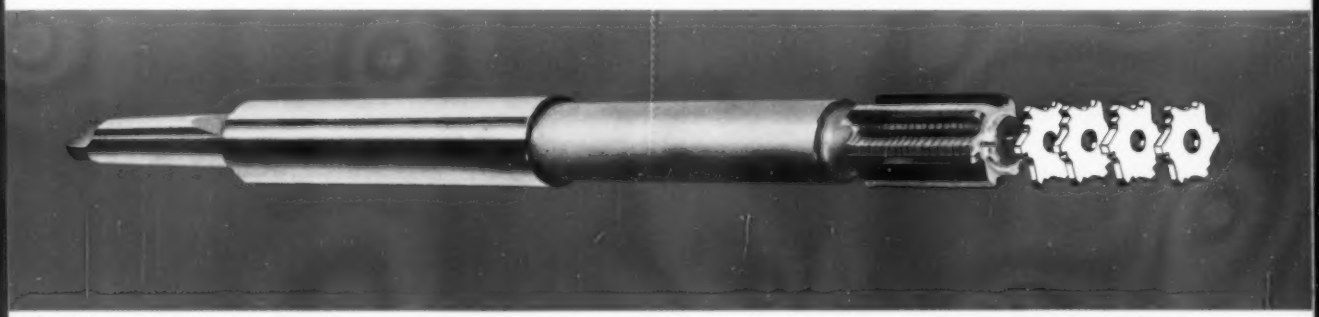
- Expensive machining operations eliminated. Savings passed on directly to user.
- Expensive finished tool inventory carried by cutting tool manufacturer eliminated. Savings passed on directly to user.
- Special carbide-tipped tools available at prices below the cost of standard type tools.
- Provides for quick delivery and off-the-shelf specials once user has arbor. Also, in many instances, present used reamers can be used as arbors with minor alterations.

COST SAVINGS ON REPLACEMENT TOOLING

- Replacement tools available at up to 50% savings over cost of original tools.
- Damaged or worn carbide tipped tools easily, quickly and economically refurbished.
- Most tools formerly scrapped can now be economically rebuilt.

TOOL CHARACTERISTICS IMPROVED

- Built-up construction increases density, acting as vibration dampener, decreasing tendency for tools to chatter.
- Close quality control over wafers used in tool manufacture assures exact duplication of rake angles and flute construction.
- Heat dissipating qualities improved.



TOOLS MANUFACTURED BY THIS NEW COST CUTTING PROCESS ARE PRODUCTION TESTED AND FULLY GUARANTEED.

QUOTATIONS ON REQUEST

SPIRAL CARBIDE Tool Company

DESIGNERS AND MANUFACTURERS OF TRUE SPIRAL AND CONVENTIONAL CARBIDE-TIPPED CUTTING TOOLS

12931 Artesian • Detroit 23, Michigan • Phone: VErmont 7-2610

get portable, precision machining anywhere

AT LOWER COST

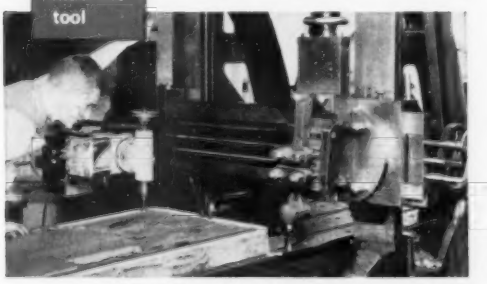
WITH DUMORE VERSA-MIL®

MILLS • BORES • SHAPES
SLOTS • GRINDS • DRILLS

only $625, No. 2 Unit, FOB Racine

Mount it on any machine tool

Cutting keyway after turning on lathe



Drilling after shaping casting on shaper

Or take it to the work

Milling Huge steel forging in place

Compact, rigid, portable. Performs in any position. Built-in power and feeds. Use independently or attach to machine tools for secondary operations. Saves handling, moving, set-up and down-time. Also used for machining in-place parts too big for standard machines. Provides close tolerance quality at *profitable* metal removal rates. Gives you the *advantage* of machining where it is most economical!

Ask your local DUMORE Industrial Supply Distributor

for a demonstration . . . at his place or in **your** shop. Ask him, too, about the many accessories for broader, lower cost machining operations in maintenance, job shop, tool room or production applications. One unit often pays for itself on one job!

You Can Do More with

DUMORE®

All-Purpose Precision Metalworking Tools

THE DUMORE COMPANY • 1310 Seventeenth St., Racine, Wis.

Versa Mil • Drill-N-Tap Units • Drilling Units • Drill Heads
Micro-Drills • Drill Grinders • Precision Grinders
Hand Grinders • Flex-Shaft Tools • Quills and Accessories

Want more details? **-- SEND COUPON**

THE DUMORE COMPANY • 1310 Seventeenth St., Racine, Wis.

Send me Versa-Mil details ☐

Name_____
Company_____
Address_____
City_____ Zone____ State_____

Use Reader Service Card, CIRCLE 31

Use Reader Service Card, CIRCLE 32

THIS VERY SECOND

YOU CAN START
TOWARD BETTER
CARBIDE PERFORMANCE

CARBIDES-CHATTER

Chatter—the things to check

1. CENTER	Cutting edge not on center line.
2. OVERHANG	Excessive.
3. NOSE RADIUS	Too large.
4. FEED	Insufficient.
5. PLUNGE CUTS	With hand feed (grooving, cut-off, etc.) increase rate of feed in proportion to increased rate of speed. (Example: if you double the speed—double the rate of feed).

6. Where entire setup of tools has been changed, tools will sometimes chatter due to extreme keenness of cutting edge. Changing a few tools at a time will help eliminate this condition.

1.

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ORDER UNIMET CARBIDE'S TOOLS, TIPS, BLANKS OR INSERTS NEXT TIME YOU BUY. THEY ARE OUT-PERFORMING OTHERS IN TEST AFTER TEST . . . DAY AFTER DAY . . . IN PLANT AFTER PLANT!

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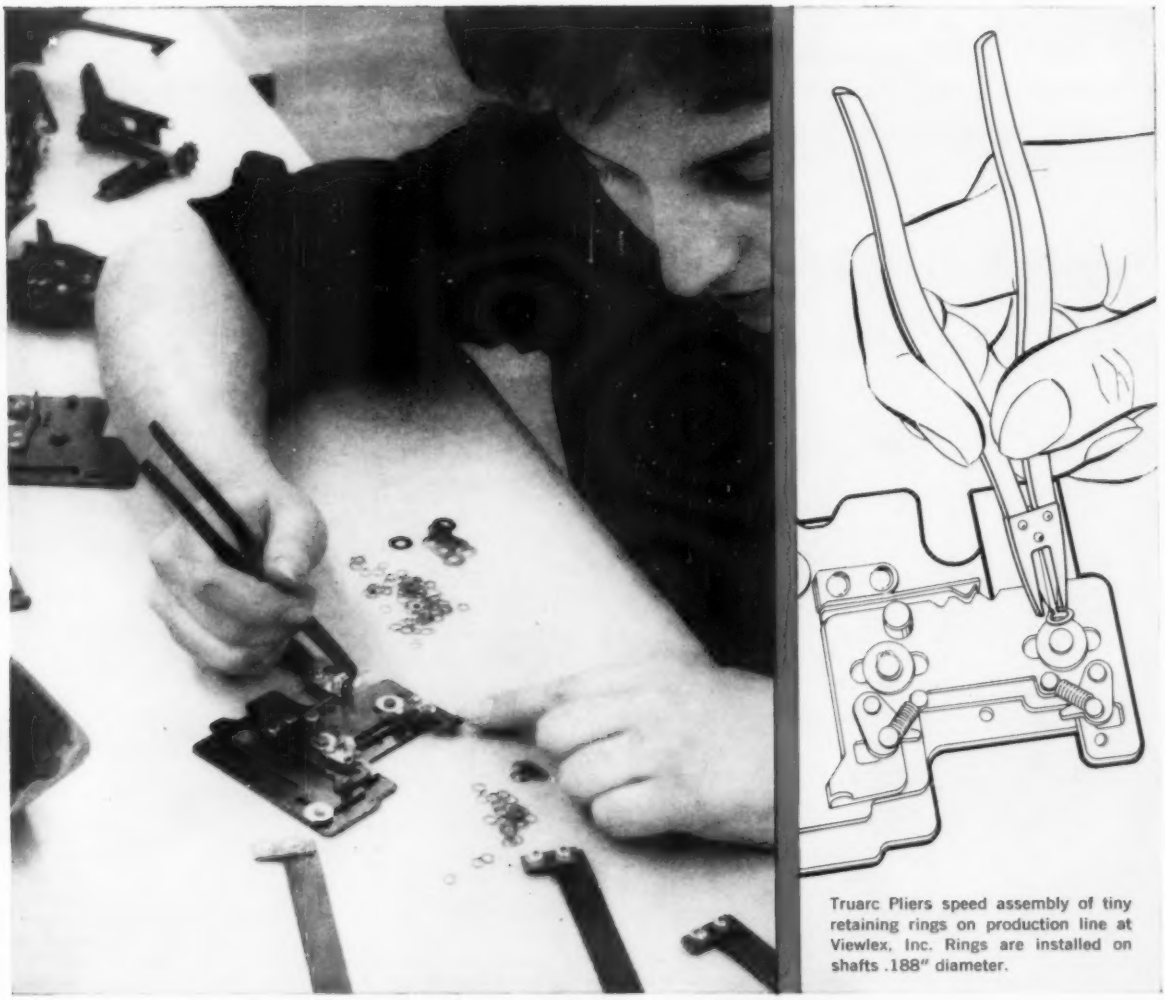

Truarc Pliers speed assembly of tiny retaining rings on production line at Viewlex, Inc. Rings are installed on shafts .188" diameter.

Truarc rings eliminate rejects, cut assembly time 40%

Production engineers at Viewlex, Inc., Long Island City, N.Y., save time, speed work with Waldes Truarc retaining rings.

On Viewlex Instruct-O-Matic automatic slide projector, the top plate assembly utilizes five Truarc Series 5100-18 external rings to secure the lost motion plate to the base.

Operator above uses Truarc Standard Plier No. 0018 for installation and removal of rings in accurately located grooves, pre-cut before the assembly is made. Precision engineered plier tips grasp tiny rings securely to speed assembly and disassembly. Pliers are pre-set to avoid over-spreading the rings.

The original design of the unit called for shoulder rivets. In addition to requiring a longer stud, the rivets were difficult to control for height consistency. As a result, when the rivets were flattened, binding or looseness between the plates often caused expensive rejects. For maintenance of the unit, it was necessary to scrap the entire assembly.

Use of Truarc rings assures precise seating of the plates and eliminates rejects caused by faulty riveting. Result: an assembly time saving of 40% at Viewlex. Use of Truarc rings may achieve similar or greater savings—in labor, machining or parts—on your production lines. These versatile fasteners come in 50 functionally different types, as many as 97 sizes within a type, 6 metals, 13 finishes.

They replace nuts and bolts, machined shoulders, threaded collars and set screws, bowed washers or springs and cotter pins, and other fasteners and fastening operations. (A wide line of semi-automatic and manual Truarc tools are available to speed ring assembly). For facts on the entire line of rings, tools and application ideas, write for the new Waldes Truarc catalogs: RR 10-58 and AT 10-58. Waldes Kohinoor, Inc., 47-16 Austel Place, Long Island City 1, N.Y. 9.16

WALDES
TRUARC®
RETAINING RINGS
Waldes Kohinoor, Inc., Long Island City 1, N.Y.

TRUARC RETAINING RINGS...THE ENGINEERED FASTENING METHOD FOR REDUCING MATERIAL, MACHINING AND ASSEMBLY COSTS

UNDERWOOD'S "IMPOSSIBLE" INSPECTION PROBLEM AND HOW IT WAS SOLVED

THESE INTRICATE PARTS go into the complex assembly at the top of the picture. This assembly masterminds Underwood Corporation's popular adding machine, *Add-Mate*.®

Precision is critical. Each odd-shaped part —whether machined, stamped, or formed— is different; yet *all* must meet close tolerances. One part, the carryover pawl arm (numbered), defied complete inspection by ordinary mechanical methods.

The stud diameter (1) and spread between stud and slot (2) of the pawl arm could be inspected using a go and no-go gage, at rates of 450 and 400 per hour respectively. For dimension (3)—stud angularity to 90° ± 1°—mechanical inspection was impractical.

Optical gaging provided a solution that was both accurate and practical. By using a Kodak Contour Projector, the inspection rate was increased by nearly 66% to 600 parts per hour—with all *three* dimensions accurately inspected.

Underwood relies on the Kodak Contour Projector, both in production and inspection, to assure adding machine accuracy. Stringent sample checks of parts help control production machine efficiency. And all finished parts receive 100% inspection.

If you have similar "impossible" inspection problems . . . if inspection for you seems to be taking too much time . . . or if accuracy isn't what you think it should be, an Optical Gaging Products* man can help you.

And when optical gaging will solve it, remember you get *more* with a Kodak Contour Projector.

You get ample, uniform working space—a constant 8" of clearance for parts and fixtures regardless of magnification.

You get brilliant, uniform illumination over the entire screen, at all magnifications.

You get highly accurate images even at the critical outer edges of the screen.

You get upright images of all inspected parts for easier reference.

These and other features of the Kodak instrument make it efficient and more valuable to you. Read about them by writing for the booklet *Kodak Contour Projectors*.

***Kodak Contour Projectors are distributed nationally by Optical Gaging Products, Inc.,** 26 Forbes Street, Rochester 11, N. Y.

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EASTMAN KODAK COMPANY, Rochester 4, N. Y.

the KODAK CONTOUR PROJECTOR

Kodak
TRADEMARK

One of a series

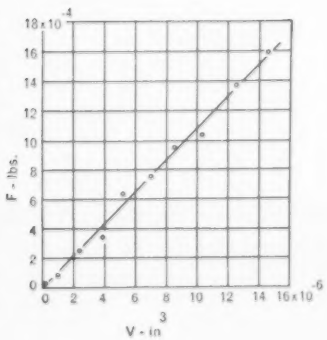
On the riddle of rolling friction

It doesn't take much to roll a hard ball across a hard, smooth, level surface – actually only about 0.00001 times the normal force acting vertically on the ball. But by careful measurement of this tiny rolling force, scientists at the General Motors Research Laboratories are helping to unravel the riddle of rolling friction.

An important relationship recently uncovered in this fundamental study: the rolling force is proportional to the volume of material that is stressed above a certain level. As a result, a GM Research group have not only confirmed the hypothesis of *how* a rolling ball loses energy (Answer: elastic hysteresis) but also have learned *where* this lost energy is dissipated (Answer: in the interior of the material, not on the surface). Mathematical analyses have indicated the exact shape of the elastically stressed volume in which all the significant frictional loss takes place.

The purpose of friction research at the GM Research Laboratories is to learn more about the elastic and inelastic behavior of materials. This knowledge – of academic interest now – will eventually give GM engineers greater control of energy lost through friction. This is but one more example of how General Motors lives up to its promise of "More and better things for more people."

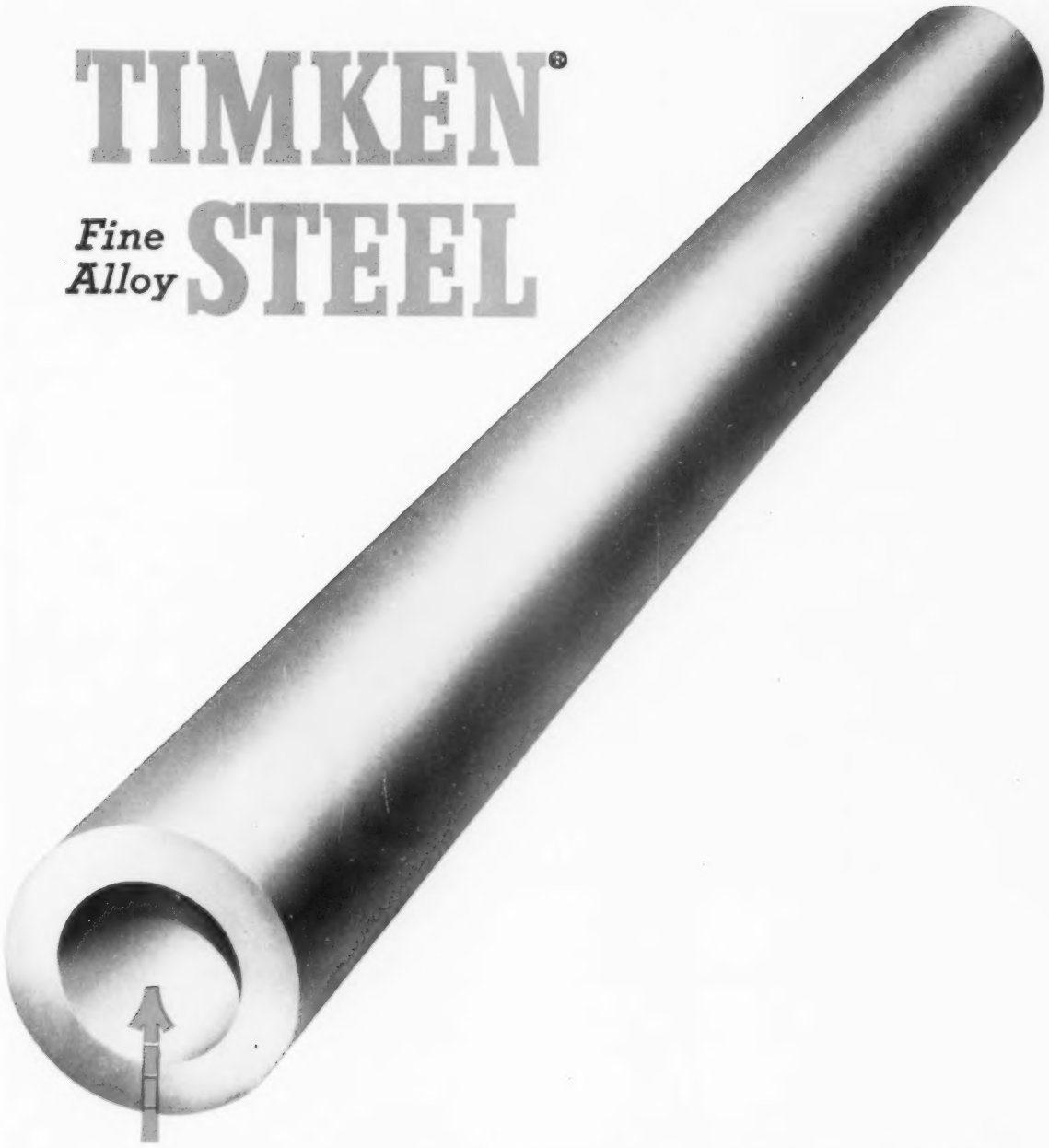
General Motors Research Laboratories
Warren, Michigan



Relationship of rolling force to elastically stressed volume.

TIMKEN®

Fine Alloy STEEL

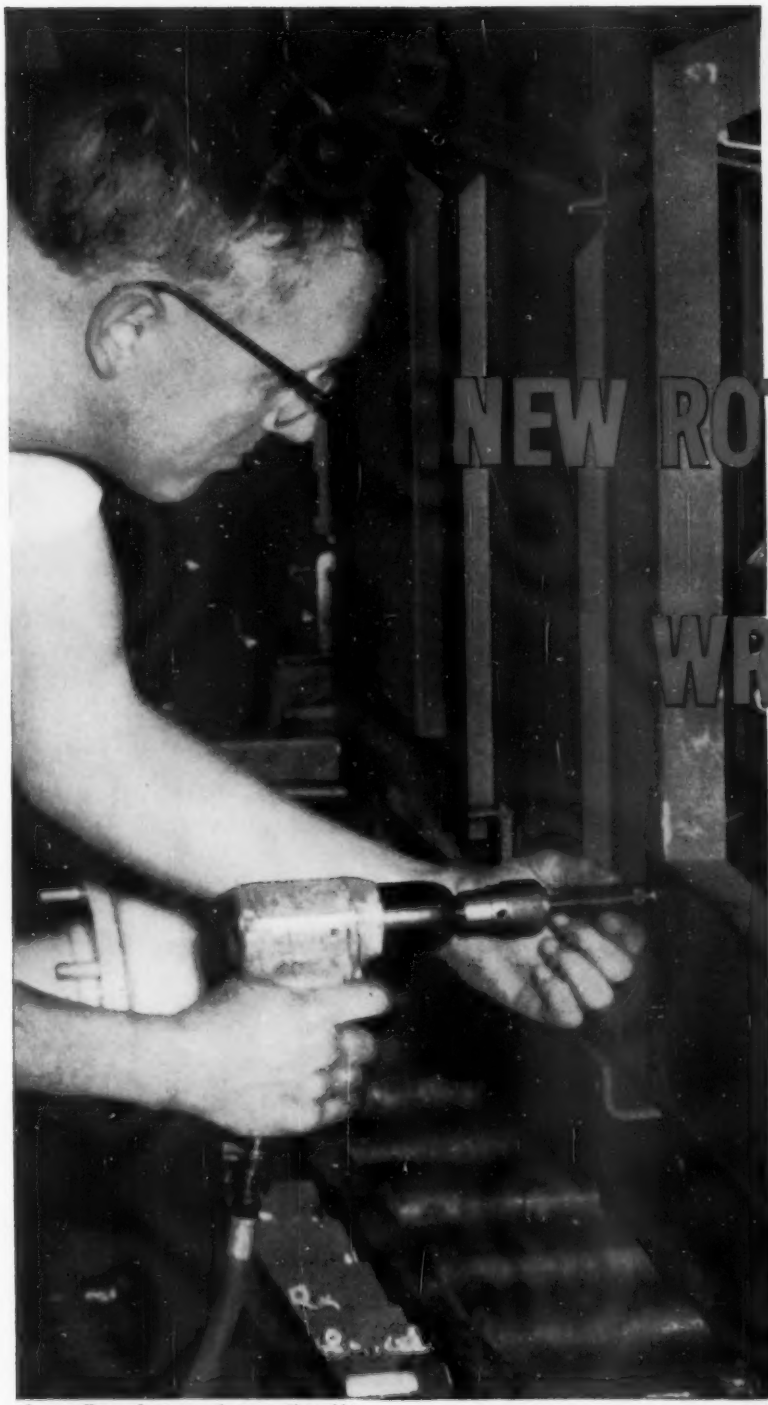


Ready-made savings for your hollow parts

Why bore out bar stock to make your hollow parts? Start with Timken® seamless steel tubing; the hole's already there. You save drilling costs, steel, machining time and you're sure of uniform quality finished parts, too. That's because we make Timken steel tubing by forging a solid round over a mandrel, thoroughly working the metal inside and out. This gives the tubing its fine forged quality and uniform spiral grain flow.

When you buy Timken steel you always get: 1) *Quality* that's uniform from heat to heat, tube to tube, order to order; 2) *Service* from the experts in specialty steels; 3) Over 40 years of *experience* in solving tough steel problems. Let our engineers help you save by recommending the most economical tube size for your hollow parts job . . . one guaranteed to clean up to your finish dimensions. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO". *Makers of Tapered Roller Bearings, Fine Alloy Steels and Removable Rock Bits.*

TIMKEN ALLOY STEEL AND SEAMLESS STEEL TUBING ARE AVAILABLE FROM WAREHOUSE STOCKS IN 44 CITIES IN THE UNITED STATES



Courtesy Davey Compressor Company, Kent, Ohio

Saves 65% of screwdriving time with...

NEW ROTOR J-20S IMPACT WRENCH

JOB: Driving hex nuts and slotted screws attaching covers to portable compressors. Formerly used universal electric tools. Took 20 minutes per cover.

RESULTS: New Rotor J-20S Air-Powered Impact Wrench, with quick-change chuck and combination bit and finder, drives ¼"-20 slotted head screws to attach covers in 7 minutes. Saves 13 minutes per cover. Assures uniform tightness. Reduces operator fatigue.

Ask for a demonstration of the J-20S or other Rotor air tools on *your* job to see how they cut your costs. Write for quotation and literature on the J-20S Impact Wrench.

ROTOR AIR TOOLS: Assembly Tools • Drills • Small Wheel Grinders
Straight Grinders • Vertical Grinders • Scalers • Chippers • Rammers
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ROTOR HIGH-CYCLE ELECTRIC TOOLS: Grinders • Polishers • Sanders

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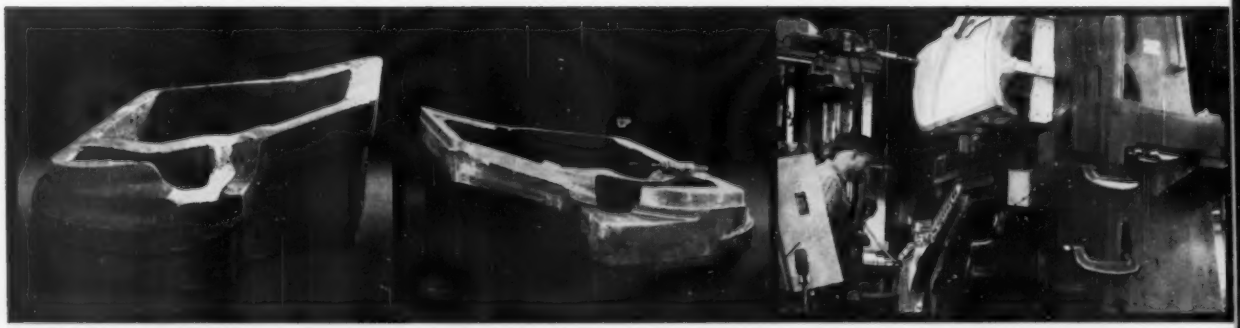
ACCURACY



MASSIVE, ROUGH CASTINGS . . . are machined quickly and efficiently on the Barth Corporation's big, powerful BG-21 KELLER Automatic Tracer-Controlled Miller.

ACCURATE MACHINING . . . on the KELLER Machine means that this big automotive die will require only a minimum of barbering.

INTRICATE 3-DIMENSIONAL SHAPES . . . like the job shown here, are duplicated quickly and accurately, as the cutter follows the sensitive tracer.

ASSURED...

...AND INTRICATELY CONTOURED DIES PRODUCED QUICKLY, ECONOMICALLY WITH

KELLER TRADEMARK® **Automatic Tracer-Controlled Millers**

One of the country's largest tool and die manufacturers, the Barth Corporation, of Cleveland, Ohio, has depended for many years on KELLER Automatic Tracer-Controlled Millers to produce large, intricately contoured dies for the automotive, aircraft-missile, appliance and other industries.

Shown opposite with one of his company's KELLER Machines, Mr. John Barth – Vice President and General Manager of Barth Corporation and newly elected President of the National Tool and Die Manufacturers' Association – states, "KELLERS do intricate die jobs not otherwise possible and do them quickly and accurately. In our plant, these machines are highly regarded and are considered the only machines for the job."

At Barth Corporation, KELLER Automatic Tracer-Controlled Milling Machines are used to reproduce large plaster full-models in tool steel, with speed, efficiency and economy – producing the dies that will manufacture components for the nation's newest automobiles and appliances. Operation is easy; there is no work spoilage and no maintenance problem.

Dies, molds, prototype parts, limited-run production – and anywhere that intricate, 3-dimensional contours must be machined with speed and accuracy – a KELLER Automatic Tracer Controlled Milling Machine can help you turn out better work at lower cost. Write now for complete information, stating the work-size range you require. Pratt & Whitney Company, Inc., *16* Charter Oak Boulevard, West Hartford, Connecticut.

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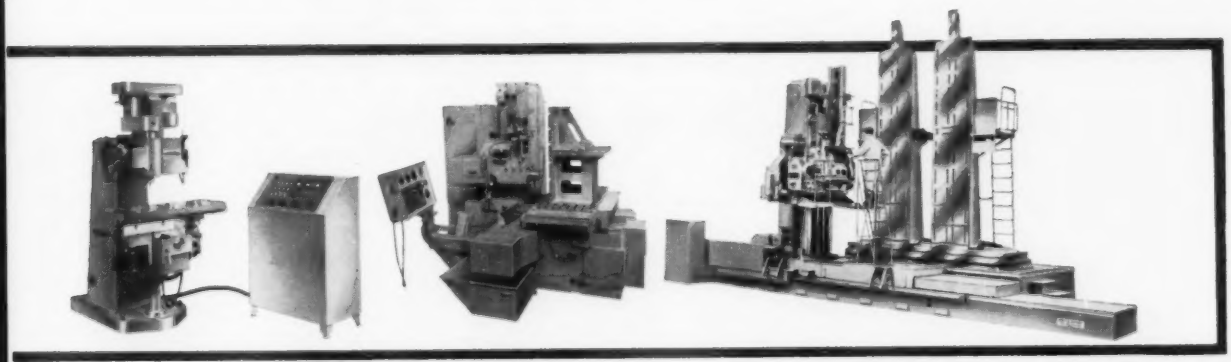
FIRST CHOICE FOR ACCURACY

MACHINE TOOLS • GAGES • CUTTING TOOLS



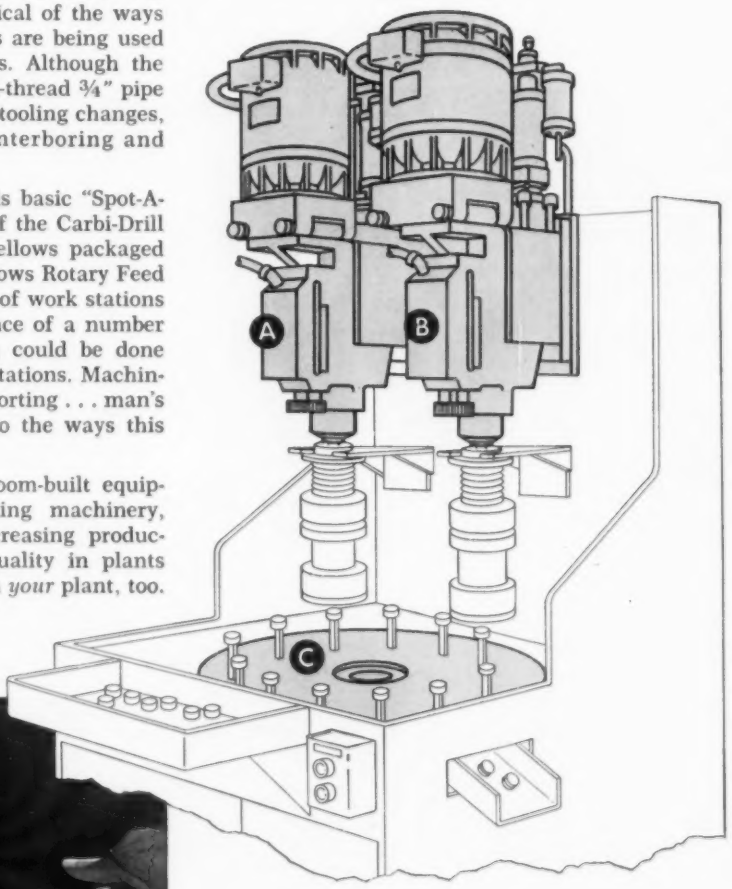
A COMPLETE LINE OF KELLER MACHINES . . . for every work size requirement is produced by Pratt & Whitney. From the compact Type BL (center) to the giant Type BG-22 (right), they provide travel capacities from 36″ x 20″ to 20 ft x 7 ft. Also included is the precision VELVETRACE® (left) with non-contacting tracer control capable of duplicating the finest detail to "tenths" accuracy.

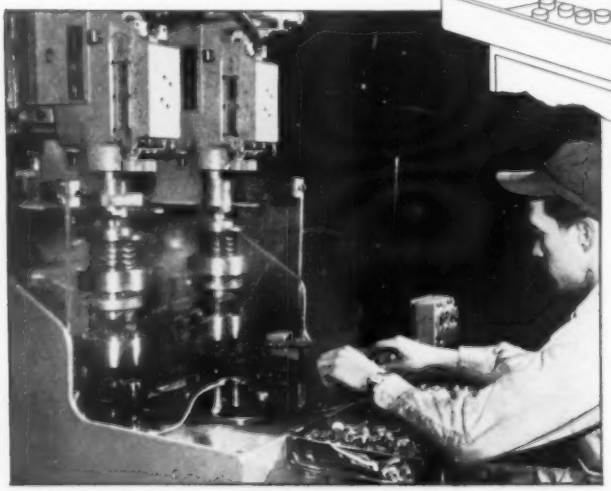
CHANCES ARE YOU CAN USE THIS "SPOT-A-MATION" IDEA TO CUT YOUR COSTS

Simple, inexpensive and easily built in the user's own shop, this "Spot-A-Mation" Idea is typical of the ways Bellows "Controlled-Air-Power" devices are being used to cut costs in all types of industries. Although the machine illustrated here is used to roll-thread ¾" pipe plugs, this same unit, with only minor tooling changes, can perform drilling, tapping, counterboring and similar operations.

Think of the many possibilities in this basic "Spot-A-Mation" Idea. For example, in place of the Carbi-Drill units, Bellows Air Motors or other Bellows packaged work units could be used with the Bellows Rotary Feed Table. On the work table, the number of work stations could be increased to permit a sequence of a number of operations, or the same operation could be done simultaneously at a number of work stations. Machining, forming, assembling, packaging, sorting . . . man's ingenuity is virtually the only limit to the ways this "Spot-A-Mation" Idea can be used.

Both as the basis for low cost, toolroom-built equipment and in spot-automating existing machinery, Bellows "Controlled-Air-Power" is increasing production per man-hour and improving quality in plants throughout the world. It will pay off in *your* plant, too.





Essentially, this machine consists of two heavy duty Bellows Carbi-Drill units, "A" and "B", equipped with roll thread heads and synchronized with a Bellows Rotary Feed Table, "C", which positions work pieces. Operation is continuous and automatic. Operator merely feeds; parts are ejected automatically. Production is double that of former equipment, less skilled operators are used and rejects have been virtually eliminated.

THIS SPOT-A-MATION IDEA FILE IS YOURS ON REQUEST

Contains complete information on the above "Spot-A-Mation" Idea so, that you can adapt the Bellows Rotary Feed Table with Carbi-Drill units or other Bellows packaged work units for use in your own plant, plus installation data, wiring diagrams and equipment lists for scores of other Bellows "Controlled-Air-Power" applications. Write for yours today. Address Dept. TE–260, The Bellows Co., Akron 9, Ohio.

681-C

The Bellows Co.

DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

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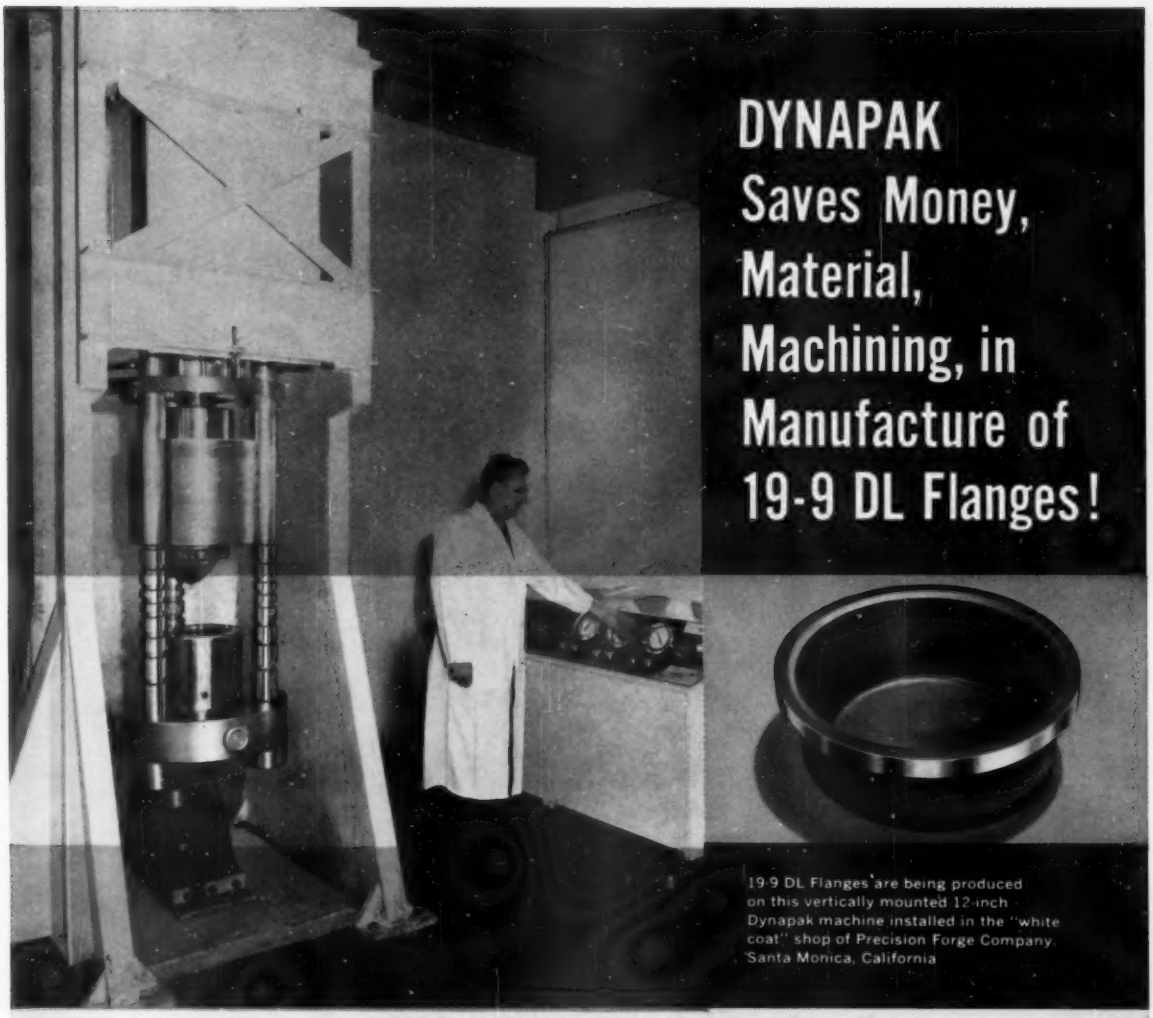

DYNAPAK Saves Money, Material, Machining, in Manufacture of 19-9 DL Flanges!

19-9 DL Flanges are being produced on this vertically mounted 12-inch Dynapak machine installed in the "white coat" shop of Precision Forge Company, Santa Monica, California

Here are the savings achieved in this Dynapak Application:

- MATERIAL: 60%
- TOOLING: 50% of the cost of conventional forging dies
- MACHINING: Reduced by more than 50% due to forging tolerances of 1/32 in. and elimination of draft angle.

PLUS

- PRODUCTION RATES: 70-80 per hour
- SUPERIOR PHYSICAL CHARACTERISTICS: Greater strength, uniform and controllable work-hardening, Grain Size No. 11.

Dynapak, industry's first operational high-energy-rate machine tool, offers a breakthrough in metalworking's long-sought goal to produce forgings that can be used with little or no machining. This flange is just one of many forgings now being produced commercially by Dynapak. For complete information regarding application of pneumatically-energized Dynapak in your forging, extrusion, forming, or compaction operations, write, wire, or phone:

DYNAPAK

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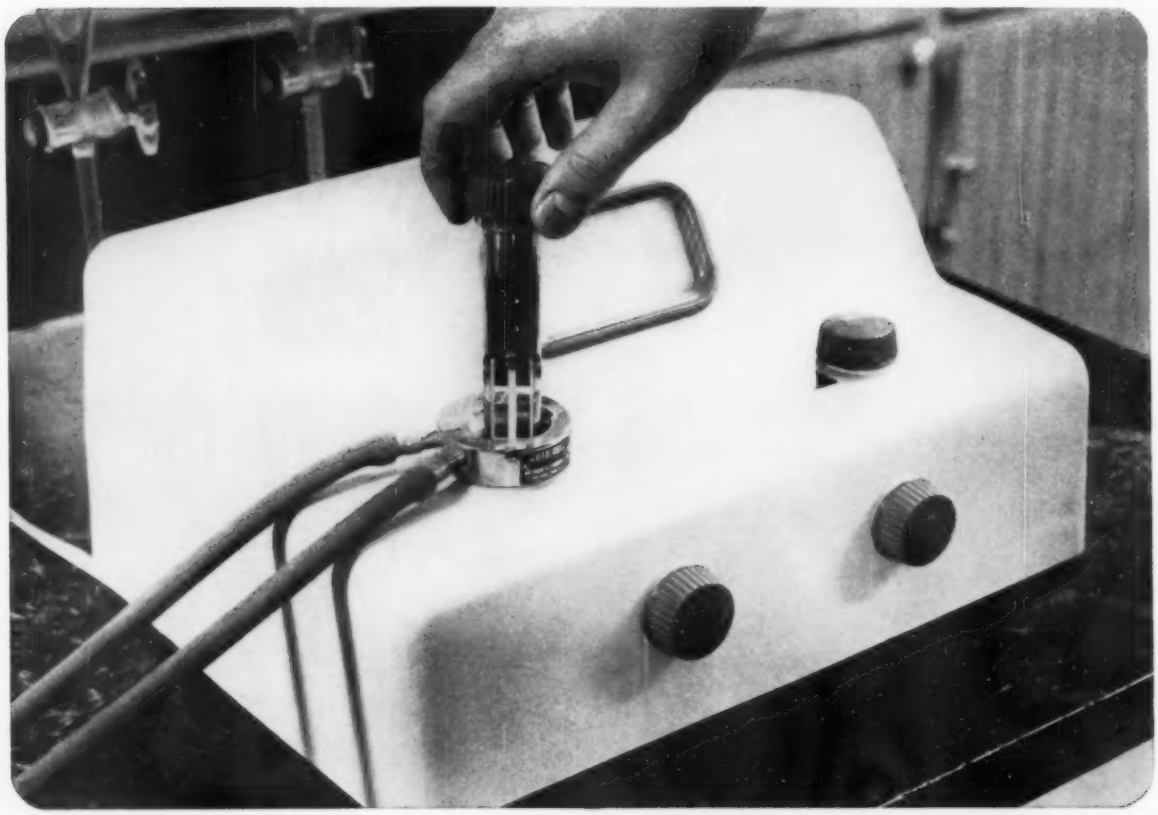
***Experience**—the added alloy in **Allegheny Ludlum** tool steels*



COLORIMETER (inherently extremely accurate) determines percentages of molybdenum, tungsten, cobalt and manganese in A-L tool steel to insure consistent, high quality.

Colorimeter measures exact chemical composition of Allegheny Ludlum tool steel melts

Accurate adjustment of alloys guarantees uniform heat treatment, predictable dimensional changes, reduced grinding, standardized machining operations.

Close control of molybdenum, tungsten, cobalt and manganese is at the heart of a good tool steel melt. In addition to the usual testing methods, Allegheny Ludlum's chemical laboratory checks these metals with Colorimetry because of its inherent, extreme accuracy.

On the basis of the Colorimeter's findings, it is possible to make carefully calculated furnace additions of ferro-alloys, insuring precise control over chemistry. This guarantees your receiving the *exact* analysis order after order, providing *uniformity of heat treatment, predictable dimensional changes, reduced grinding and standardized machining operations.*

Colorimetry is but one step toward careful control over composition. Allegheny Ludlum also sets exacting purchasing specifications on raw materials and scrap. Quality Control checks all incoming orders to see that they conform with these specifications. Another guard toward your getting your exact specifications: each ingot bears a metal tab showing heat number.

Allegheny Ludlum stocks a complete line of tool steel sizes and grades. Call your nearest A-L representative; you'll get quick service and counsel on such problems as heat treating, machining, grade selection, etc. Or write for A-L's publication list which gives full data on the more than 125 technical publications offered. They'll make your job easier.

ALLEGHENY LUDLUM STEEL CORPORATION, Oliver Bldg., Pittsburgh 22, Pa. Address Dept. TE-26

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Tool Steel warehouse stocks throughout the country... Check the yellow pages

every grade of tool steel... every help in using it

TURBO-CUT

the tap that's changing the meaning of "high production"

The reports we're getting from our field men on Turbo-Cut Tap performance are self-explanatory.

Here's a sample from one day's mail:

"This tap was run on an aluminum carburetor part and started to run undersize after 32,160 holes."

"We currently have a 5/16-24 Turbo-Cut that is still going after 18 shifts and over 43,000 holes."

"A #10-24 Turbo-Cut plug tap ran 18,200 holes on a zinc die cast job."

Threadwell's Turbo-Cut is piling up records like these daily. Every plant interested in increased production should take a look at the tap that really means "high production". See your Threadwell Distributor now for details.

Only Threadwell makes the genuine Turbo-Cut.

Threadwell
MAKES THE BEST PRODUCT BETTER

INDUSTRIAL DISTRIBUTORS
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Wesson Presents a New Era of Progress with the all-new

WESSON T-A*

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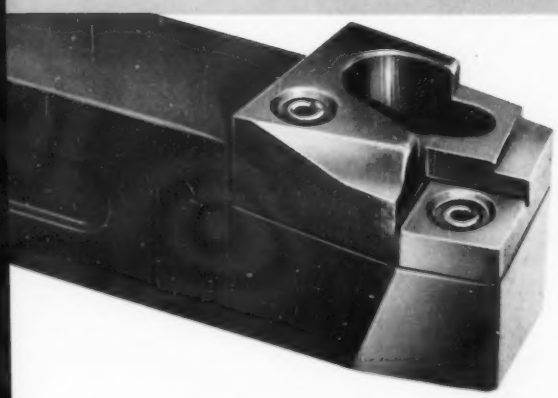
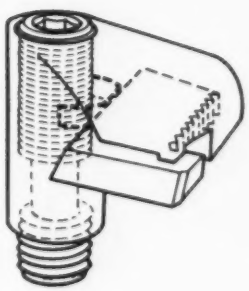
Now after two years research and 25 tested prototypes, Wesson brings to industry the all-new Wesson T-A*. Completely new in design, performance and value, the Wesson T-A* simplifies your tooling for throw-aways, saves time, effort and money. It has just two units plus the tip, yet gives full adjustability, within its range, for *any* insert or chipbreaker setting. Tool changes and adjustments are made quickly, easily, regardless of holder position or orientation. Write today for detailed information on the all-new Wesson T-A*.

JUST TWO SIMPLE UNITS





NO. 1 SHANK UNIT—A semi-permanent "assembly" consisting of 4 replaceable parts—shank, anvil-locator with coined seat and two roll pins attaching the anvil to the shank. No adjusting required.

NO. 2 CLAMP UNIT—Its four parts—clamp, compound screw, spring clip and chipbreaker—can't come apart in use or when indexing tips. Stainless steel spring clip retains chipbreaker in any position.

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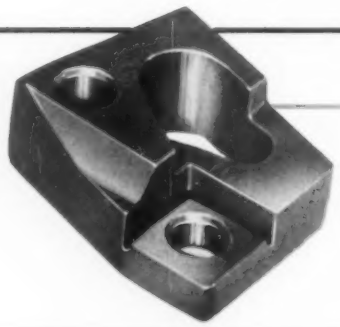
SEE OTHER SIDE

SIMPLICITY MEANS SAVINGS

you handle more jobs with less tooling with the *New* WESSON T-A*

Here's Why:

The new Wesson T-A* has fewer *and simpler* parts. Indexing is fast, sure. Chipbreaker adjustment is easy, positive. One Allen wrench serves any tool. Design permits absolute repeatability of settings.



2 in 1 Anvil-Locator with Flat Anvil Seat

Precision, one-piece investment steel casting for maximum strength and rigidity. Coined seat assures flatness. Zero side overhang permits compact ganging of tools. Designed for 3/16" thick inserts but can also use 1/8" with locked-in shim. Fine detail in holders makes possible use of inserts with radii as small as 1/64". Protects shank, easily replaceable when damaged. New shank purchase unnecessary.

Wide Range, Vise-Jaw Type Clamp Unit

Fast, parallel clamping at all times. No breakage of inserts or chipbreakers when indexing or changing inserts. Complete clamp assembly rides up and down on compound screw. Large clamping range. Set low, set back and relieved so chip will not hit clamp. Can be used without chipbreaker on cast iron, etc. Design prevents incorrect reinsertion if assembly is removed from shank.

Adjustable, Solid Carbide Chipbreaker

Adjustable over wide range, with vertical and visible serrations. Regrindable six times. Supported and spring-locked in channel of clamp yet easily adjusted or removed with fingers. Rides up and down with clamp when indexing, cannot drop out.

* THROW-AWAY

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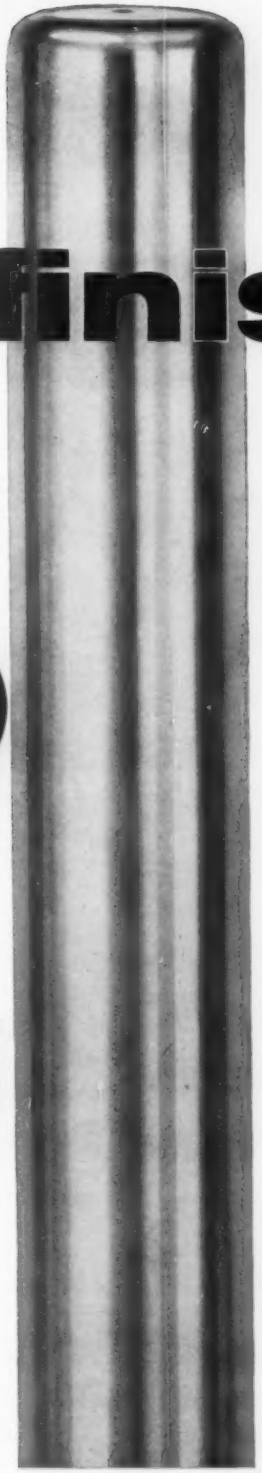

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MAXIMUM SURFACE HARDNESS

LONGER PIN AND BUSHING LIFE

GREATLY REDUCES POSSIBILITY OF SCORING

The process of Super Finishing removes the soft outer skin (approx. .0002-.0003) caused by the heat induced as a result of grinding.

Super Finish eliminates charging which is common to pins lapped with an abrasive compound.

Super Finishing, long a prerequisite in the Automotive and Aircraft Industry for precision bearing surfaces, is now a standard on Superior guide pins. With Super Finished guide pins ideal clearances can be maintained due to a greater bearing surface.

Write for the NEW 28 page Superior Catalog Today!!

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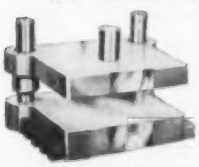

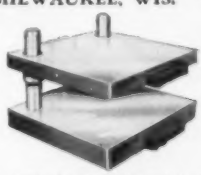

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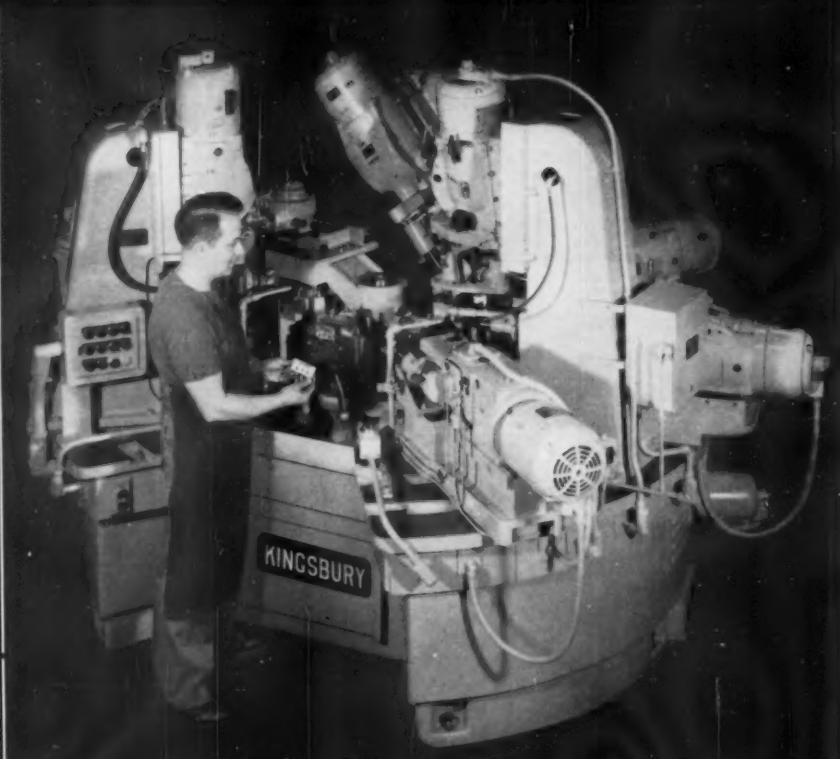
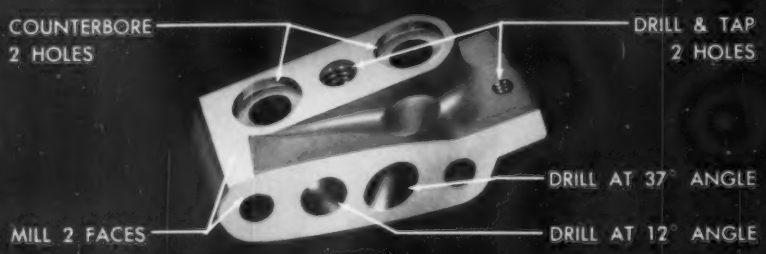


10-spindle Kingsbury combines milling with other operations



ADAPTER FOR AUTO AIR COOLER

Two units each mill one face with a finish better than 80 micro. Both units are at the operator's left — one vertical and one horizontal.

On the right are five units — angular, vertical and horizontal. They operate on four holes — drill, counterbore and tap.

Production is 360 parts per hour gross. Seven duplicate work fixtures (on a 30-inch index table) make possible operations on six parts while the operator changes parts at the loading station.

All this is on a base 96 inches in diameter. This saves floor space.

Oil mist lubricates the milling and multi-spindle heads.

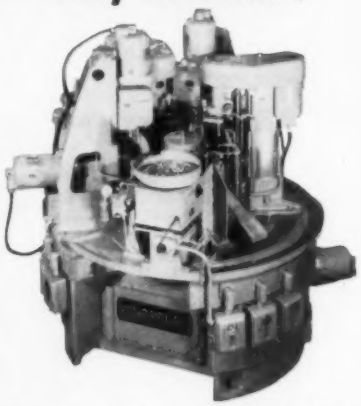
The customer returned his base, index unit and operating units to us for retooling. That was a real saving. And he has the Kingsbury assurance of good basic design, rugged, accurate construction, and test runs before shipment.

For high production at low cost, ask to have our representative call and talk over your jobs. Let him get you a specific proposal. Kingsbury Machine Tool Corp., Keene, New Hampshire.

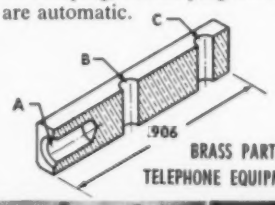
KINGSBURY

MULTI-UNIT AUTOMATICS

High production in minimum space — fully automatic



Gross production for this 8-spindle Kingsbury is 1,400 parts per hour for drilling the three holes, countersinking A and burring B and C top and bottom. Parts are fed from the hopper via a chute to an air-operated loading mechanism. Clamping, unclamping and ejection are automatic.



BRASS PART FOR TELEPHONE EQUIPMENT

1,000,000 cycles a year for 30 years with no serviceman

In November, 1929 Shakespeare Co. of Kalamazoo, Mich. set up this Kingsbury with their fixtures. It drills five holes and reams two in a part used in fishing tackle. Net production rate is 600 parts per hour.

Vice-President Earl Clickner (behind the operator) says, "We have never had to call a serviceman on it. We have run it for thirty years — about a million cycles a year — and it still gives us almost no trouble."

Will PRODUCTION LAPPING Prove Beneficial in MY Plant?

Get The Answer With

YOUR OWN FREE ANALYSIS

FROM THE *Lapmaster*® TECHNICAL SERVICE

It's easy to prove to yourself whether production lapping will benefit your own manufacturing process...improve your product performance. Just send a few sample parts with surface finish specifications and production requirements to the Lapmaster Technical Service.

We'll test run them in our experimental lapping laboratory and furnish you with a full production report. This complete special analysis will give everything you need to determine how profitable the Lapmaster will be in your plant. Lapped samples will enable you to positively check product improvement.

More than 80% of the successful Lapmaster installations now in daily operation started with just such an analysis . . . and in the majority of cases, the results have shown substantial savings. However, if the application is not practical or profitable for you, we are frank to report it.

TECHNICAL BULLETINS FOR YOU—If you want additional information immediately, write for these latest technical bulletins on producing and measuring precision flatness and finish.

View of our experimental lapping laboratory showing some of the equipment available to test run your sample parts.

Our lapping laboratory is also equipped with the finest checking instruments to insure an accurate report of every experimental job.

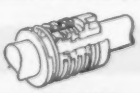
WHAT YOU CAN EXPECT FROM A LAPMASTER

- Surface finishes of 2 to 3 RMS and surface flatness within tolerances of .0000116" with absolute uniformity piece after piece.
- No production bottlenecks frequently caused by other lapping methods.
- No downtime for truing lap plate . . . conditioning rings automatically keep plate flat and true.
- Product performance and quality improved . . . rejects cut to a minimum . . . inspection costs reduced.

Crane Packing Company, 6469 Oakton St., Morton Grove, Ill. (Chicago Suburb)
In Canada: Crane Packing Co., Ltd., Hamilton, Ont.

John Crane

MECHANICAL PACKINGS



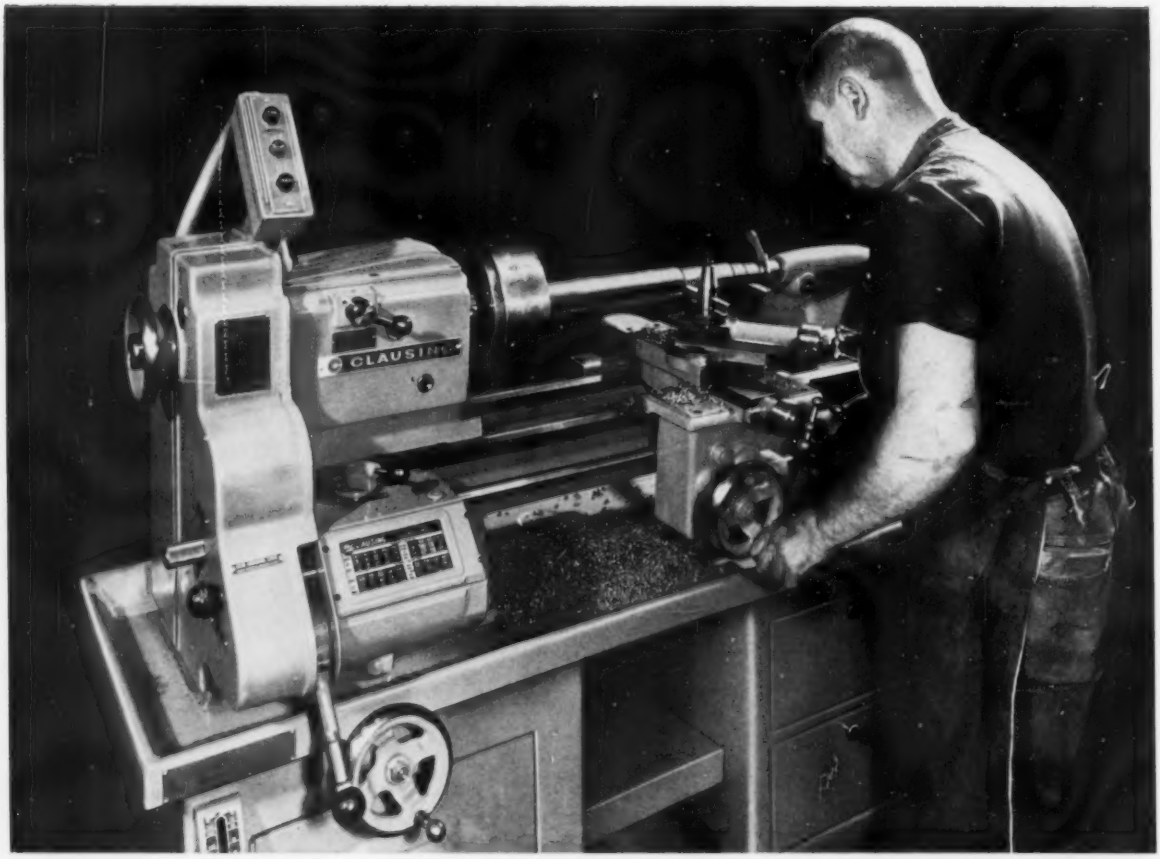
SHAFT SEALS

TEFLON PRODUCTS

LAPPING MACHINES

THREAD COMPOUNDS

CRANE PACKING COMPANY



Now . . . crown-shaved gears standard equipment on Clausing 12¾" lathes!

All gears on Clausing lathes are crown-shaved for quieter, smoother operation and greater accuracy than ever before. It's another PLUS feature that makes Clausing truly outstanding among lathes in its class. Here are a few of the many more—

(1) Flame-hardened bed ways standard equipment at no extra cost.

(2) Heavier throughout—"have more guts than most of our machines costing 3 or 4 times as much."

(3) Forged steel spindle, with L-00 or 2¼"-8 threaded nose.

(4) "Zero Precision" Timken tapered roller bearings.

(5) Choice of heavy-duty variable speed or 10-speed countershaft, with clutch and brake optional.

(6) Verified precision—factory test report accompanies each lathe.

The result . . . this user report is typical of the performance and value you get in Clausing lathes: "After investigating the lathe field very thoroughly our choice was Clausing, and subsequent performance exceeded our expectations. We recommend the Clausing 6300 series lathes as the competition-beating answer in their capacity range." (signed) K & W Machine Works, Springfield, Mass.

See Clausing . . . check, feature for feature, dollar for dollar . . . before you buy any lathe of comparable size. See for yourself why Clausing is acclaimed the outstanding lathe value.

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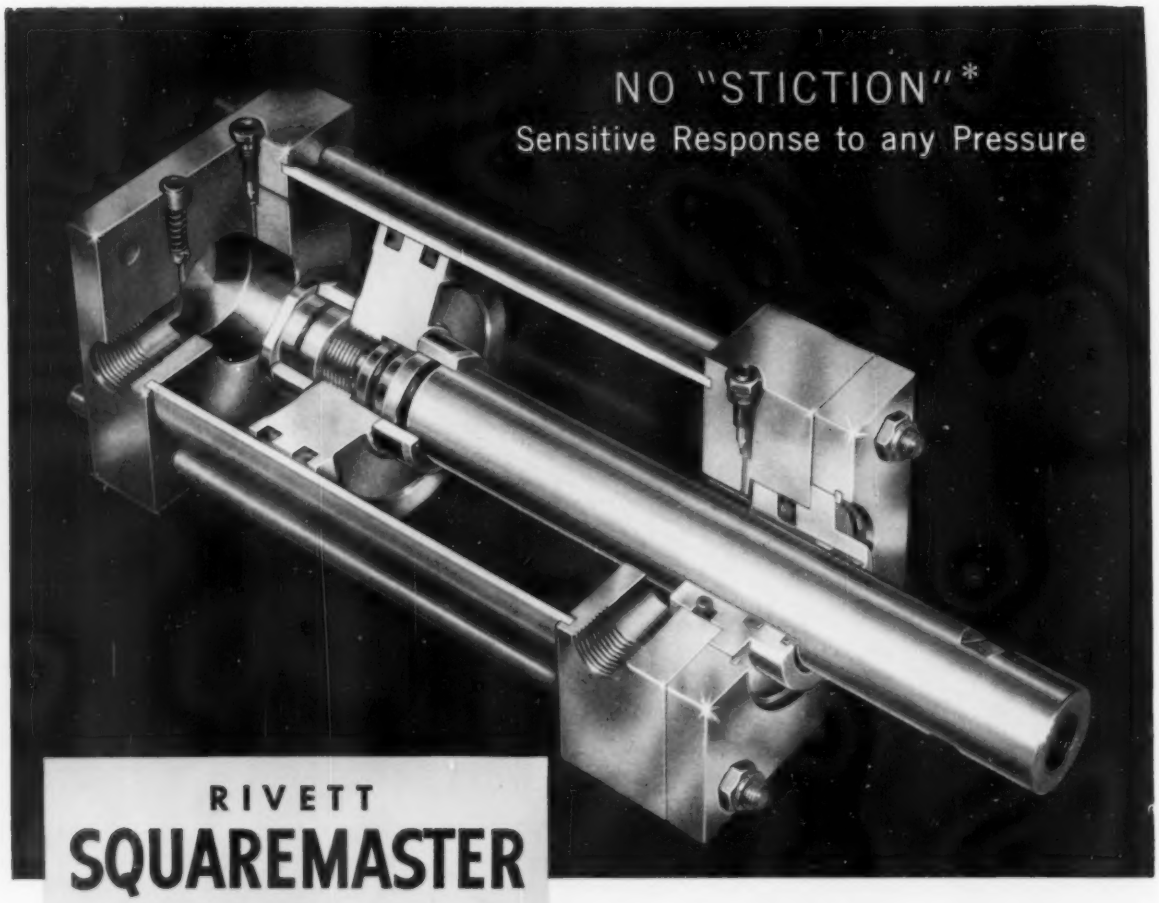

RIVETT SQUAREMASTER "100" CYLINDERS

Unfailing POWER for MILLIONS of cycles!

Here's sure power for unfailing cylinder operation. SQUAREMASTER 100's are the world's finest constructed cylinders—perform with 100% efficiency! 200 P.S.I. air to 500 P.S.I. oil. Available in 7 mountings with standard dimensions, in 10 bore diameters, internal and external threading. Special models and cover combinations. Priced competitively; prompt delivery; meet all J.I.C. requirements.

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*Initial High Coefficient of Static Friction

POWER-PACKED FEATURES PROTECTED BY POWER-GUARD CONSTRUCTION

1. Piston rod. Ground and polished alloy steel. Hard chrome-plated. **2.** Piston rod bearing. Replaceable cartridge-type. **3.** Piston packing adjusts automatically. V-block packing minimizes friction. **4.** Correctly stressed tie rods. **5.** Cushion bushings. Bronze, floating type. **6.** Ports rotated to any 90° position. **7.** Steel covers. Take minimum mounting space.

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RIVETT furnishes a complete power package

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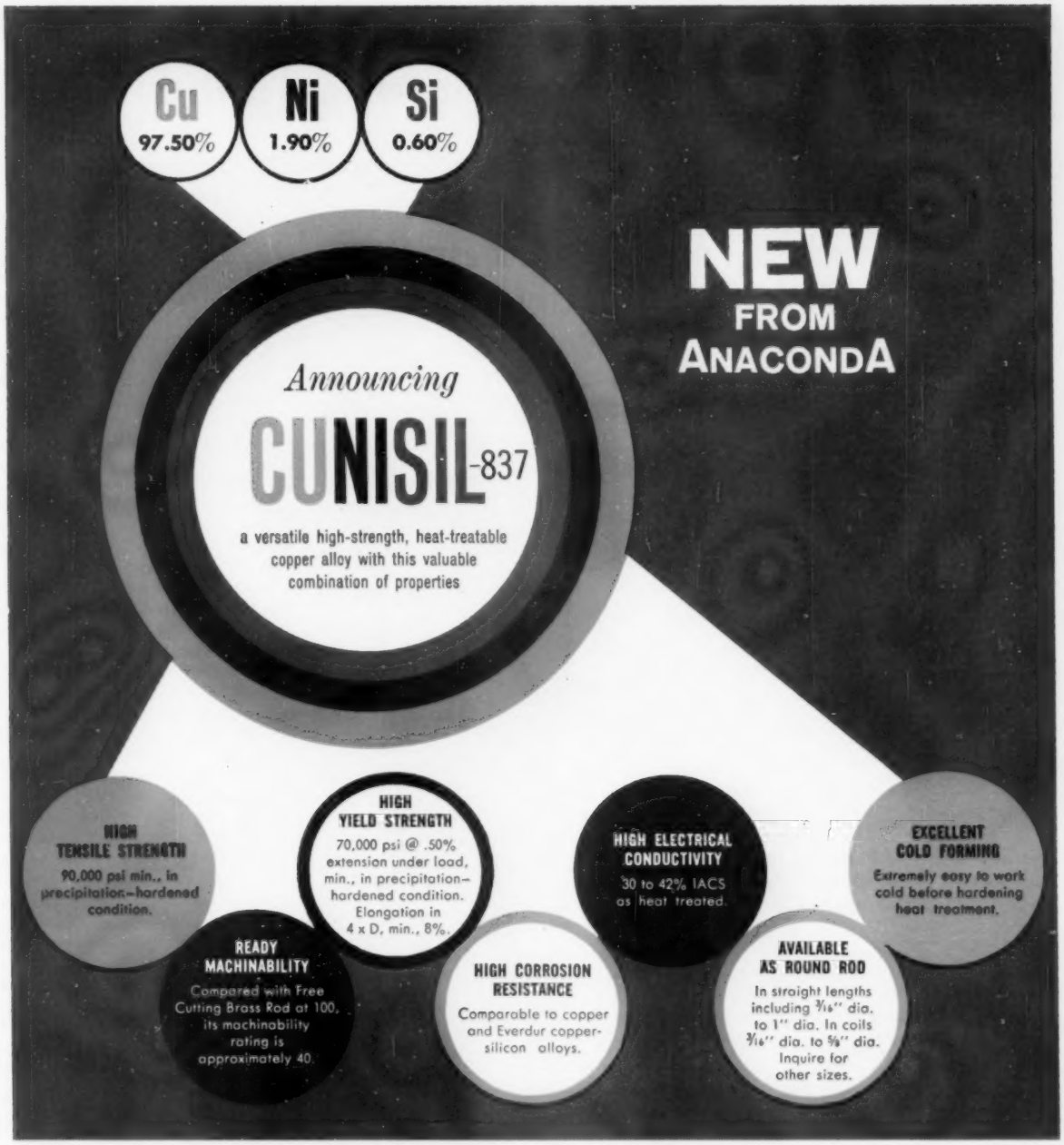

METALLURGICAL COMMENT. Most of the nickel and silicon in heat-treated Cunisil are present as an intermetallic compound, nickel silicide, and it is the precipitation of nickel silicide in the form of particles of submicroscopic size by a relatively low temperature heat treatment that accounts largely for the distinctive properties of the alloy.

Prior to the hardening heat treatment, the alloy is brought to a proper condition for hardening by giving it a solution anneal at a much higher temperature and then a quenching from this temperature; at this stage the alloy is quite soft and in a condition for drastic cold-working operations. The hardening heat treatment consists of heating at a controlled temperature for a definite length of time to obtain the desired mechanical properties.

CUNISIL-837 is a high-strength, corrosion-resistant alloy that includes many of the desired qualities of Silicon Bronze or Everdur®. Its applications to date have been primarily in the electrical equipment field.

FOR MORE INFORMATION—see your American Brass representative or write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 8047

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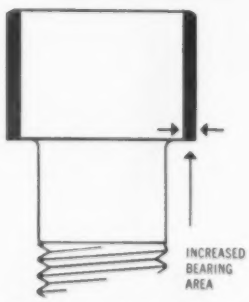
MADE BY THE AMERICAN BRASS COMPANY

Up to 2⅓ times as much holding power!

Up to 100% longer fatigue life!

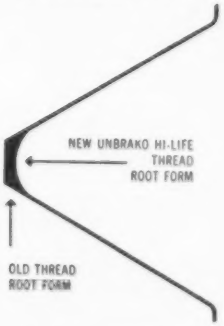
New UNBRAKO *pHd** Hi-Life socket screws increase mechanical reliability of your assemblies without increasing production costs

Stronger in the head



New pHd head features increased bearing area, more powerful wrenching socket; provides up to 2⅓ times as much clamping force without indenting bolted material. This permits higher preloading, which in turn helps prevent fatigue failures or loosening under vibration.

Stronger in the thread



Smoothly radiused root of new Hi-Life thread distributes stress concentrations at point where 85% of screw failures occur, practically doubles fatigue life. New thread—exclusive with UNBRAKO—fits standard tapped holes and nuts, requires no special gaging or assembly techniques.

Here is the one new socket head cap screw that is redesigned *throughout*. UNBRAKO pHd Hi-Life is the only standard socket screw offering you both the new, larger pHd head (1960 Series) *and* new UNBRAKO Hi-Life thread.

Because of increased bearing area under the head, you can tighten a pHd Hi-Life tighter without indenting bolted material. This safeguards vital preload; protects against loosening under shock or vibration. At the same time, the new Hi-Life thread form drastically reduces stress concentrations at the root, where most screw failures occur. Result: up to 100% increase in fatigue life.

Both the pHd head and Hi-Life thread originated in the SPS laboratories for advanced fastener research where they were first developed for ultra-high-strength aircraft bolts. Recognizing the critical need for greater mechanical reliability in industrial and consumer goods as well, SPS now offers these refinements in a standard commercial fastener.

New UNBRAKO pHd Hi-Life socket screws are available to you immediately in sizes ¼ through 1 inch, plain or cadmium plated, with or without the Nylok† self-locking feature. They cost no more, require no change in assembly or gaging procedures. See your authorized UNBRAKO distributor or write SPS—manufacturer of precision threaded fasteners and allied products in many metals, including titanium. Request Bulletins 2406, 2577.

†T.M. Reg. U.S. Pat. Off., The Nylok Corp.

TENSION-TENSION FATIGUE TESTS PROVE LONGER FATIGUE LIFE OF UNBRAKO HI-LIFE THREAD FORM

Screw Size: ½-20 Testing Speed: 1050 cpm

	Cycle Life	
Alternating Stress in psi (000 omitted)	Old Thread Root Form	UNBRAKO Hi-Life Threads
2-20	2,076,000	8,000,000*
3-30	598,000	1,808,000
4-40	120,700	232,350
5-50	56,650	89,950
7-70	22,900	40,000

*Test stopped—no failure

INDUSTRIAL FASTENER Division

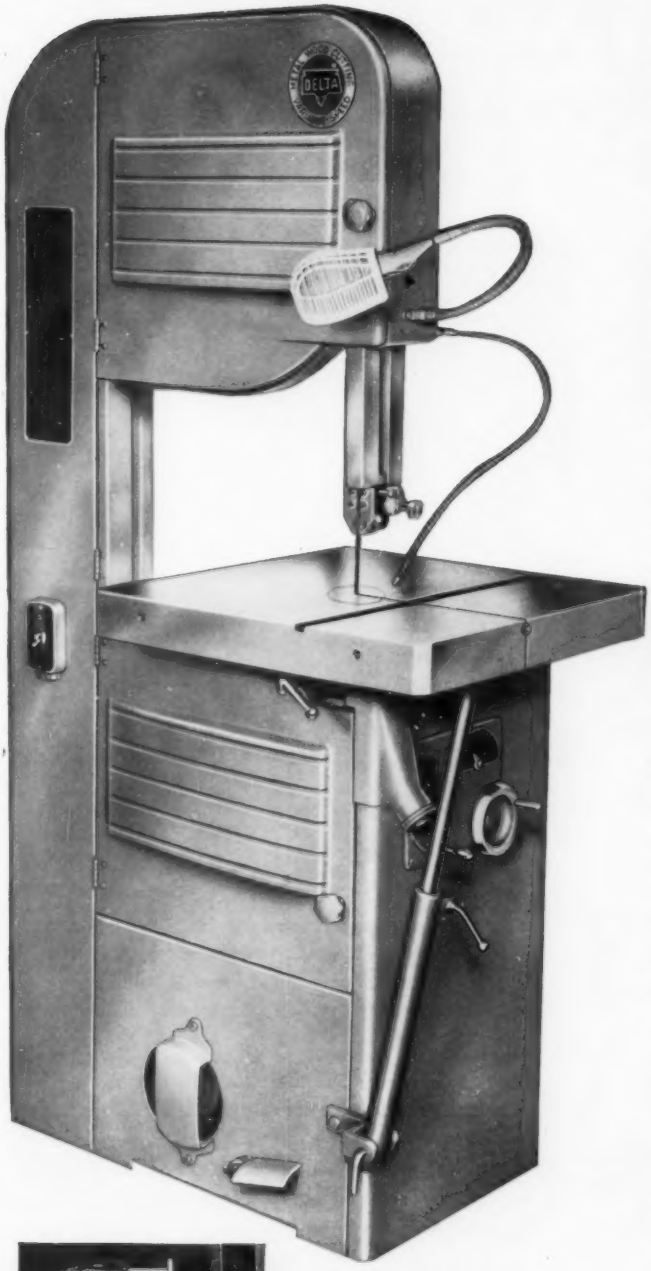
JENKINTOWN 37, PENNSYLVANIA

SPS

where reliability replaces probability

*pHd stands for "proper head design"—a factor in higher product reliability

NEW from DELTA



20" metal-wood *variable speed* BAND SAW

No matter what your cutting requirements —in the foundry, toolroom or pattern shop —this all-new Delta 20" Metal-Wood Band Saw gives you real on-the-job performance. Now—*for less than $900.00*—you can have the features you said you wanted most for greater accuracy and better cutting:

WIDE RANGE VARIABLE SPEED DRIVE... gives you a tremendous speed range—50 to 4500 FPM—for cutting everything from stainless steel to aluminum, wood and plastics. This versatility can't be equalled.

SCIENTIFICALLY DESIGNED BLADE GUIDES... ideal for heavy metal cutting because they furnish more "close up" blade support than conventional type guides. These new Delta blade guides are the key to better accuracy, straighter cuts, and longer blade life.

RUGGED FRAME CONSTRUCTION... features a massive, rigid internal frame with a modern fabricated exterior. Exclusive 3-point adjustability (wheels, upper guide and table) assures perfect alignment of key components.

In addition to these outstanding features you get a massive table with double trunnion support, convenient speed controls, plus built in chip blower *at no extra cost.*

SEE IT AT YOUR NEAREST DELTA DEALER—he's listed under "TOOLS" in the Yellow Pages—or write: Rockwell Manufacturing Company, Delta Power Tool Division, 620B N. Lexington Avenue, Pittsburgh 8, Pa.

BLADE WELDER, including shear and grinder, shown on No. 28-462 Bracket mounted on 20" Band Saw for machine-side use. (Optional accessories)

DELTA INDUSTRIAL TOOLS

another fine product by

ROCKWELL

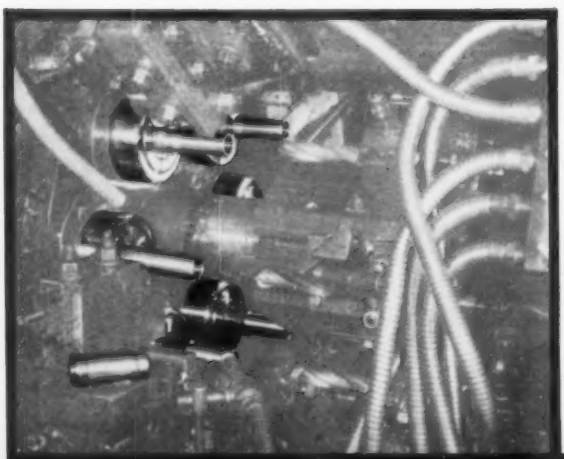
HARDINGE
ELMIRA, N.Y.

When Ordering Automatics

Specify **HARDINGE Style "S" Sure-Grip Master Collets and Pads**

and **HARDINGE Style "B" Master Feed Fingers and Pads**

Photo of Model 601 New Britain Automatic courtesy New Britain-Gridley Machine Division.



Your automatics perform best with HARDINGE Master Feed Fingers and Master Collets. The name HARDINGE is your guarantee of accuracy and durability . . . allows you to reap the full benefit of the inherent accuracy of your machines.

HARDINGE Master Collets are ***the only masters with no work pressure on the screw*** . . . last longer . . . retains accuracy.

HARDINGE Master Feed Fingers and Pads save 30% to 80% over conventional solid feed fingers.

All sizes for all automatics.

Prompt Delivery from these Stock Locations: Atlanta, Boston, Chicago, Dayton, Detroit, Elmira, Hartford, Los Angeles, New York, Philadelphia, Seattle, Portland, Minneapolis, Oakland, St. Louis, Toronto.

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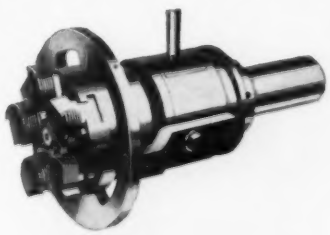
Namco Collapsible Tap Passes Tough Test at TOWMOTOR...

"NO SPOILAGE PERMITTED"

Because I.D. honing and other costly machining precedes internal tapping of outer jackets for hydraulic cylinders, Towmotor Corporation specified a Namco RST Collapsible Tap to insure "no spoilage" tapping. Supplied with a 5-chaser circular head and installed on existing turning equipment, the tap cuts perfect Class 2 threads . . . *on every piece;* meets Towmotor's rigid requirements with ease.

Namco Collapsible Taps can be used for long or short runs and on rotating or stationary spindle machines. Long life circular chasers can be ground to micrometer settings with cost-cutting consistency. They're adjustable to all diameters with a full range of sizes to meet your most demanding applications . . . 1¾" to 7½"; 5" to 15½".

Write for complete details on how Namco Collapsible Taps boost profits through better tapping.



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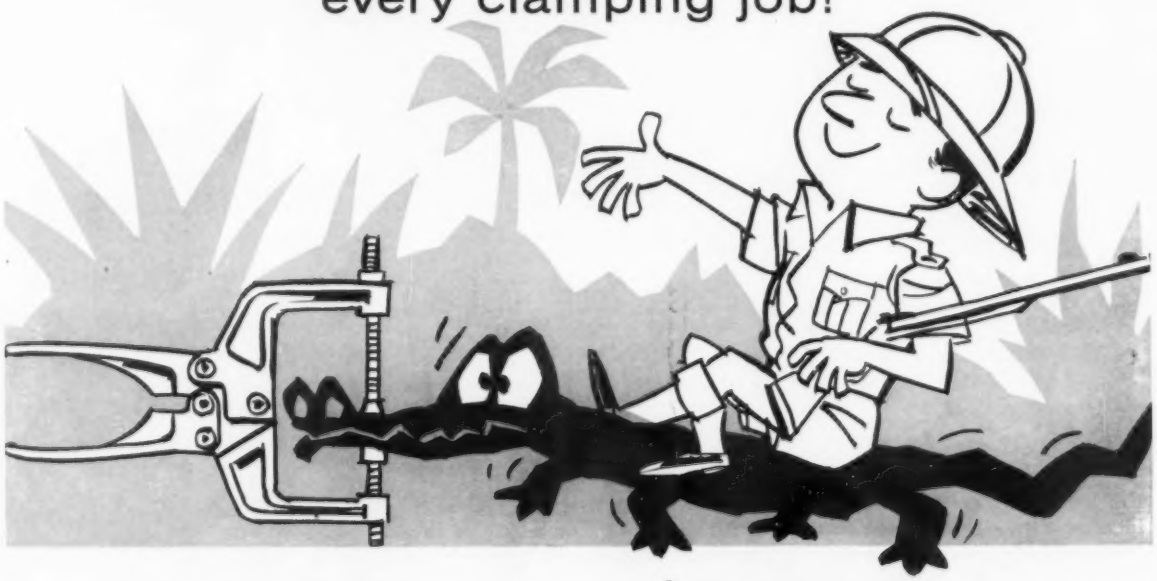

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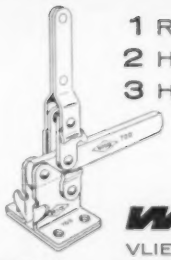
made better three ways to give more positive holding, last longer!



1 Reamed holes
2 Hardened serrated bushings
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send for free catalogs describing Wespo clamps and fixture details

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. . . when it's a matter of TAP and GAGE precision!

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STANDARD HAND TAPS

High Speed Steel Ground Thread

- Two and Three Flute
- Spiral Pointed
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PIPE TAPS

High Speed Steel

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PLUG, CYLINDRICAL and THREAD GAGES

- **RING THREAD GAGES and INTERNAL MICROM-ETERS**

Selection of taps and gages on the basis of the lowest initial cost often results in the highest production cost . . . a fact that is known by every "thinking man" on this important panel.

They know they can save time and money with fewer rejects due to the uniform accuracy of the BATH line of standard and special cutting tools . . . and gages!

Another outstanding BATH feature is the availability of BATH engineering service . . . always ready to help solve tap and gage problems, big or small. Ask for the new BATH catalog on your business letterhead.

LOOK FOR THE BLUE BATH BOX!

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(See listing in June 15, 1959 Tool Engineer Supplier's Directory Issue)

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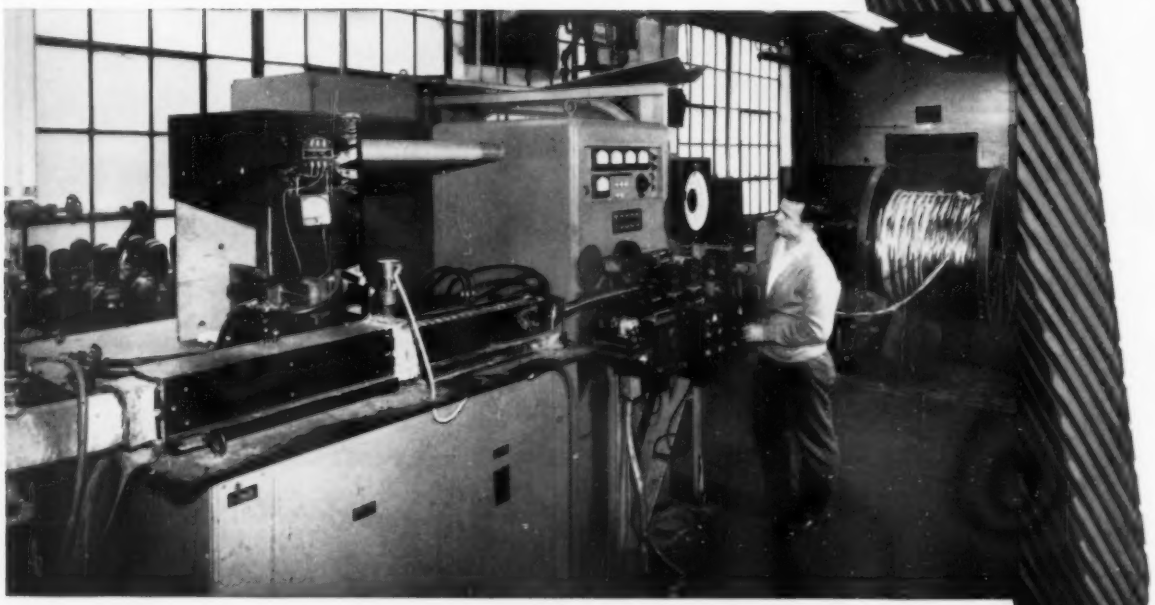
FOR THE BEST BUY. . . BUY BATH!

How TOCCO* Induction Annealing makes copper cable easier to handle in the field . . .



A world famous manufacturer of quality cable now treats its customers to the best with TOCCO-annealed cable that's easier to reel off, easier to splice and generally easier to handle in the field. Cable segments pass continuously through a TOCCO inductor coil at the rate of 23 feet per minute for the 800 mcm material illustrated. Many sizes of cable segments, up to one million circular mils, are annealed on one TOCCO unit.

TOCCO's many advantages over conventional annealing methods include:

1. TOCCO provides "bright annealing"—no discoloration.
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3. TOCCO's output is nearly four times that obtained by conventional annealing methods.
4. TOCCO equipment requires one operator as opposed to three required for the bell-type furnace operation.

Whether your products involve ferrous or nonferrous materials, look to TOCCO for an economical solution to your metal heating problems—annealing, brazing, hardening, melting or heating for forming or forging operations.

JUST PUSH A BUTTON

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*Trade Mark Reg. U.S. Pat. Off.

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Please send copy of "Typical Results of TOCCO Induction Hardening, Heat Treating and Annealing."

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Ten Short Years

What are the 10 biggest stories of the past 10 years? Newspaper editors from coast to coast conducted a poll to find the answer. I think mention of their findings might serve to recap our perspective.

1. *The Korean War.*
   Fought with up-to-date implements on a restricted basis, the war served as a proving ground for military inventions with exception of the atomic and hydrogen influence.
2. *Coming of the Space Age.*
   This is probably the most significant development insofar as our profession is concerned—new methods and materials.
3. *Ike's first election and subsequent illnesses.*
   Remember the stock market fluctuations and their effect on expansion of industry?
4. *Stalin's death and Khrushchev's inauguration.*
   Since this event our scientific, engineering and political interests have focused more toward the recognition of Russia as an economic threat than a military one. (Beware of this.)
5. *School integration.*
   This has had little or no effect on our technical society.
6. *The Hungarian revolt.*
   We have taken some lessons from this. At least the necessity for preparedness should be clear-cut.
7. *Introduction of the Salk vaccine.*
   Through science, research effort, and ingenuity, almost any problem can be solved whether it applies to man or machine.
8. *The Army-McCarthy hearings.*
   There is nothing technical in this one, however, the issues involved provided subjects for house cleaning in politics and appraised industry of the possible hazards affecting the future.
9. *Khrushchev's visit to America.*
   Here is more proof of the effect of communications. Almost any poll indicates that we know more about Russia and vice versa since his tour of the U. S. If it is good for heads of state, it is good for engineers.
10. *Death of Pope Pius XII and succession of John XXIII.*
    These numerals indicate that both Pius and John have been preceded by others in the same capacity. To be sure, there will be others to follow just as others will follow you and me with improvements to the factors of life.

Most of these top ten have had a direct effect on manufacturing in our country. We could do well to review them and many others not mentioned in the interests of self-preservation, protection of our families and insurance for the future.

PRESIDENT
American Society of Tool and Manufacturing Engineers

METALOGICS

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RYERSON PLUS VALUES

...how it works for you

Broadens Scope of Selection

Know a single source where you can get aircraft-quality alloys such as 9310, Nitralloy, and 4340 to A.R.T.C.-14 . . . as well as all standard commercial alloys and free-machining types? This is typical of the size and diversity of Ryerson stocks. Here, right at the tip of your dialing finger, are thousands of tons of steel and aluminum—in virtually every standard type, size and shape. Also, hard-to-get intermediate sizes and special analyses are readily available. This is true of Ryerson stocks, year in and year out—in all but periods of extended production shutdowns.

Brings Newest Developments

Remember when lead was first added to carbon steels for faster machining...when, a little later, leaded alloys came along? Ryerson stocked them for you first. And remember just recently when the world's fastest machining steel tubing and bars (Ledloy® 170 tubing and Ledloy 375 bars) were introduced? Again, Ryerson brought them to you first.

Gives New Measure of Quality

Quality—now there's a word that's worn thinner than an office-seeker's shoe sole. But Ryerson Metalogics has given it new meaning, with a brand-new set of rigid quality-control standards that are completely detailed and published for your scrutiny. They govern every aspect of specifications, verification, packaging, cutting and certification of all Ryerson products. If you want a tangible example of the scope of this new quality program, take a good look at Ryerson cutting tolerances. Then see if you can find any that are held more closely.

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"Expert" is another worn-out word we hesitate to use. But we do put at your disposal the industry's most experienced men. They're ready to give you the benefit of their nationwide, daily experience with all kinds of problems—material selection, fabrication and the ever-present specter "cost of possession." And remember, nowhere else will you find as wide a range of published technical information to help you in your metalworking operations. It's yours for the asking.

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Here's a company you should get to know better for our primary business is that of satisfying customers. And we've kept a lot of people satisfied over the last 100 years. We'd like to satisfy you, too.

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Why not discuss the exciting story of Metalogics with your Ryerson representative soon. You'll find he can help you in more ways than you might think—to meet all your requirements for steel, aluminum, plastics and metalworking machinery.

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tool engineering

in RUSSIA

the long-range plan

By N. G. Neuweiler
Editor-in-Chief
Schweizer Maschinenmarkt
Geneva, Switzerland

Present targets for the USSR include expansion of both heavy industry and the machine tool industry. Automation is already applied extensively and a survey of the present state of Russian industry indicates that there is already an extensive utilization of modern tool engineering principles. These principles will be applied intensively during the next few years in an economic race with the U.S.

TODAY RUSSIA TRAILS the United States in industrial production by a substantial margin. This margin is growing smaller year by year. Russia has fully recovered from the ravages of World War II, has become the second-largest producer of manufactured goods in the world and, if present long-range plans are effectively implemented, will achieve equal industrial status with the United States within twelve years.

On the basis of past performance, planned goals will be achieved. Russian industry has developed rapidly: total production in 1958 was five times greater than in 1940. Capital investments after World War II increased at the rate of 13 percent yearly. During that period some 12,000 large industrial enterprises were built and put into operation throughout the country.

This industrial development has been aided—and in a sense made possible—by rapid advances in machine tool design and machine building. During the past five years more than 4500 new types of machines, mechanisms and instruments have been developed, including 400 new types of machine tools. In 1957, some 130,000 machine tools for working metals were built—a 111 percent increase over 1955.

Russian planners are counting on a 200 to 300 percent increase in production in the main branches of Russian industry during the next 15 years. As compared with 1957, iron ore production should increase 3.5 times during that period, the production of crude oil 4 times, that of iron and steel 2.3 times and production of electrical energy should increase 4 times. Such increases are based on planned increases in machine tool production and the development of more efficient machines and automation equipment.

Machine builders in Russia must guarantee to improve the productivity of industry by greatly increasing their output of machine tools, presses and the like. Foundry and forging equipment must be made more efficient, and progress in the mechanization and automation of all metalworking production is emphasized. Not less than 1300 automated production lines are planned for the next few years. Development of special multistation machine

About the Author

Trained as an engineer, N. G. Neuweiler has for many years been editor-in-chief of the Swiss metalworking magazine *Schweizer Maschinenmarkt* ("Swiss Machinery Market.") With his knowledge of the Russian language and background in metalworking, Mr. Neuweiler is well qualified to report on Russian industrial developments. His article is based entirely on information from Russian sources.

tools, numerical control equipment and automatic punch presses and machines for precision casting are among the stated objectives of the machine building industry.

Beginning with the automation of individual machines and production lines, it is planned to ultimately automate entire plants. In this connection, computers will be used to control manufacturing processes. Mass production of standardized building-block automation units is being considered.

Parallel with increased volume of production and high productivity, the cost of production is scheduled to be reduced by some 11.5 percent in the 1959-1965 period. According to a statement in the March 1959 issue of the Russian technical journal *Sanki i Instroument*, earnings of workmen should increase about 40 percent during the same period. Working hours are scheduled to be reduced to 30-35 hours per week.

Before World War II, the USSR built neither special machine tools nor high-precision machine tools. All machines in these categories were imported. Starting in 1945, the Russian machine tool industry started building special and precision machine tools. During the past several years there has been a considerable increase in the number of special machine tools built. These include high-precision automatic and semiautomatic machines, combination machines and transfer machines. In 1957, three times as many special machines were built as in 1950. Special machines represented 33 percent of the total types of machine tools built up to early 1958: 295 types or design of special machines were listed as compared to a total of 605 standard designs.

More than 80 of the types of precision machine tools are essentially modifications of standard machines. Certain elements of the standard machines are replaced and relatively slight modifications of design are carried out. About 24 types of high-precision machines have also been made, as well as four models of what the Russians call "master machine tools"—models designed for machining certain highly accurate parts for precision machine tools.

The Russian machine tool industry produces equipment that is comparable to that produced in the United States. Among the special machines that have been produced recently are gear-hobbing machines using carbide-tipped tools; gear milling machines for cutting straight or helical teeth; a considerable range of thread grinding machines for producing external and internal threads; grinders for spur gear wheels (these machines are fitted with a microscope for checking the profile of the abrasive wheel); grinders for generating bevel gear wheels with helical teeth and hypoid gears; semi-automatic vertical lathes with fixed spindles acting in parallel, hydraulic feeds and automatic parts feeders; six-spindle automatic screw machines for bar stock up to one inch diameter; and semi-automatic machines for precision finishing of crankpins.

For the past several years, Russian machine

Progressing from lines of standard machines connected by materials handling equipment, the Russians have developed special transfer machines using building-block components.

builders have been producing machine tools with program control, transfer machines and automatic inspection machines. Tape controls are also in evidence. These are of two types: a two-coordinate system, utilizing punched tape and a three-coordinate system utilizing magnetic tape. The controls themselves are of universal types and can be used on various machine tools without modification.

A numerical control system for center lathes is operated by punched tape. This transistorized system can be fitted to center lathes without the need for significant machine modifications.

Practically all of the stepped shafts and crankpins required by the automotive and tractor industries are produced on automatic transfer machines. The machines consist of semiautomatic tracer lathes and transfer mechanisms for transporting parts from machine to machine.

Use of transfer machines has paid big dividends in Russia. They have resulted in an eight-fold increase in productivity, with an 80 percent decrease in manufacturing costs, according to Russian production authorities in a recent report.

Automatic piston inspection machines measure all significant dimensions and sort out pistons into "accepted" or "rejected" groups. Accepted pistons are then sorted according to size and are automatically marked. The rejected pistons are sorted into "reparable" and "scrap" groups. This machine is fitted with a device for counting accepted and scrap pistons. Lights show the results of measurements. Output is about 1000 pistons per hour.

Russian tool engineers have also developed machines for automatic inspection of ball and roller bearing rings. The rings are sorted into four groups by electropneumatic sensing elements—acceptable, nonreparable scrap, reparable rejects. Rings where the axis of the bore is not at right angles to the raceway are placed in the fourth group. Production is some 900 rings per hour.

A machine for sorting tapered bearing rollers utilizes multiple electric contacts to check diameter and taper. Rollers are sorted into 30 size categories and two reject categories. Automatic machines also

The Seven-Year Plan

Growth of the economy of the USSR has traditionally been based on long-range plans. Objectives of most of the five-year plans were, by and large, fulfilled. The current seven-year plan calls for the development of heavy industry in Russia on an unprecedented scale and for the expansion of the machine tool industry on a similar large scale.

Some targets for 1965 are production of 65-70 million metric tons of pig iron, or 65-77 percent more than in 1958; an increase in steel production to 86-91 million tons, or 56-65 percent more than in 1958; and a corresponding increase in the production of other materials.

Some comparable production figures for manufacturing machines and equipment are shown in the following:

Type of Machine or Equipment	1965 Production Target	Percentage increase Over 1958
Metal-cutting machine tools, units	190-200,000	40-50
Specialized machine tools, units	38,000	100
Forging and stamping machines, units	362,000	50
Automatic and semiautomatic machine lines, units	250-271	90-110
Rolling mill equipment, capacity in tons, thousands	200-220	100-120

According to N. S. Khrushchev's report on the targets of the seven-year plan, obsolete equipment will be replaced or modernized during the period. Automation will be widely introduced for the manufacture of turbines, generators, steam boilers, tractors, diesel locomotives, electric locomotives and other machines. It is expected that the rate of growth of industrial output will be eight percent annually during the period 1959-1965—three to four times the rate of growth in the United States over the past ten years.

The seven-year plan is part of a larger plan to overtake the United States in industrial production. Speaking at the 21st Congress of the Communist Party of the Soviet Union, Khrushchev said: " . . . it will probably take us another five years after completing the seven-year plan to catch up with and surpass the United States in industrial production. Consequently, by that time—or even earlier—the Soviet Union will rank first in the world both for physical volume of production and production per head of population."

Russian plants use tape control to automate short production runs.

check the surface finish of bearing balls. These machines are optical. A beam of light between 0.1 and 0.3 mm in diameter is reflected by the surface of the bearing, which is rotated in two planes. The reflection is sensed by the cathode of a photomultiplier. High reflectivity indicates a good finish.

Spark-erosion machines are used to contour complex parts of hard materials. The maximum metal-removing capacity of a Russian-developed machine is 5000 square millimeters per minute.

Standardization of the major elements of machine tools has been a major effort in Russia in recent years. Centralized production of machine elements has been organized, particularly for spindle heads, carriages, tables, slides and ways, and electrical and hydraulic controls. This allows new and modern special machine tools to be quickly designed and built.

Noteworthy research and design work has been carried out in the field of automation in Russia for several years. According to Russian forecasts, more than 30,000 automatic production lines will be in operation by 1975. Reaching this goal will require further specialization of machine tool building plants (under the Russian system, each type of machine is produced by a specialized plant that manufactures all machines of that type for the entire country), technological improvements in the machines themselves and, certainly, the mass production of all kinds of machine tools.

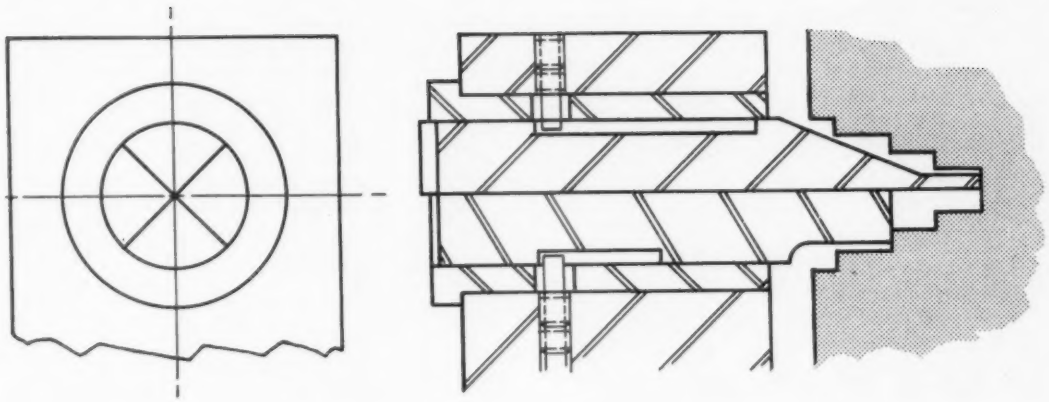
Russian experts realize that much must be done to reach long-range production goals. At a conference of Russian machine tool builders that took place in late 1958, it was observed that one of the current deficiences of the industry was that the proportion of standard, low-production types of machine tools—as compared with special automatic machine tools—was too high. This statement deals with lathes, planers and drilling machines. In 1957, for example, out of the total number of machines produced, 26.9 percent were standard lathes; 24.2 percent, standard drilling machines; 3.5 percent, standard planers; 8.2 percent, standard grinding machines. Automatic and semiautomatic machines amounted to only 7 percent of the total. Production of transfer machines is also considered unsatisfactory at present. Since World War II about 200 automatic lines with a total of some 1300 machine tools have been put into production, but even in the Russian automobile industry the number of automatic installations is insignificant as compared to the total number of conventional machine tools used in this industry.

Despite the impressive output of machine tools, it is not yet possible for Russian plants to replace all of their obsolete machines. A certain number of the machines built in Russia are reserved for export to Asia. For this reason Russia will continue to be an importer of machine tools for the next few years. Demand for precision machines is particularly high and preference is given to those suppliers who deliver most rapidly.

Summing up: the Russians have an ambitious plan for expanding and modernizing their manufacturing industries. Trends in machine tool design, the emphasis on standardization and the efforts toward full automation follow the same basic ideas that have made the United States the world leader in manufacturing. Russian tool engineering appears to be on a sound basis and it is backed up by a considerable amount of scientific research. If present plans are carried out—and the Sputniks indicate that the Russians are capable of carrying out bold plans for technological advances—the United States will have a formidable competitor for industrial leadership within a few years.

Gadgets

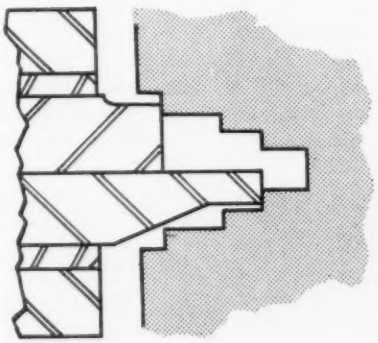
Ingenious Devices And Ideas To Help The Tool Engineer In His Daily Work

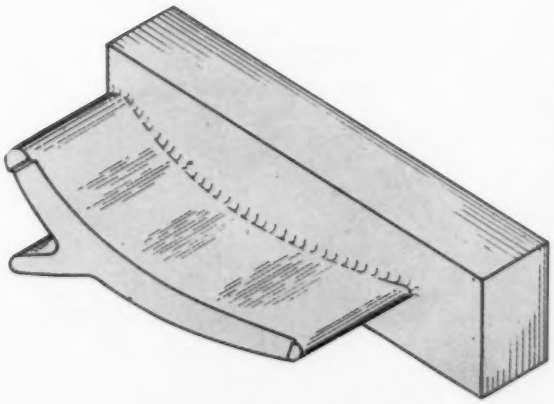


Depth Gage

By segmenting a flush-pin gage, as shown, simultaneous depth measurement to four surfaces in a counterbored hole is possible. All four of the pie-shaped segments are mounted in a bushing and retained with a dog-point setscrew. The gage may be constructed to measure six dimensions by dividing the pin into six segments.

Cliff Bossman
Dayton, Ohio

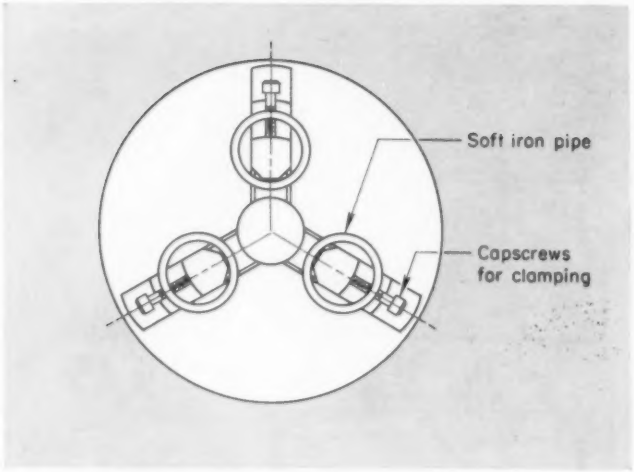




Punch Fitting Method

When fitting odd-shaped punches to die openings, it is advantageous to cut back most of the punch face about $\frac{1}{16}$ inch leaving two projections as shown. The projecting sections are fitted to the die opening first. The remainder of the punch is then fitted. The advantage of this method is that the fitted projections serve to correctly position the punch in the die while checking fit and aid location while shaving.

Clint McLaughlin
Rockaway Beach, N. Y.



Chuck Jaws

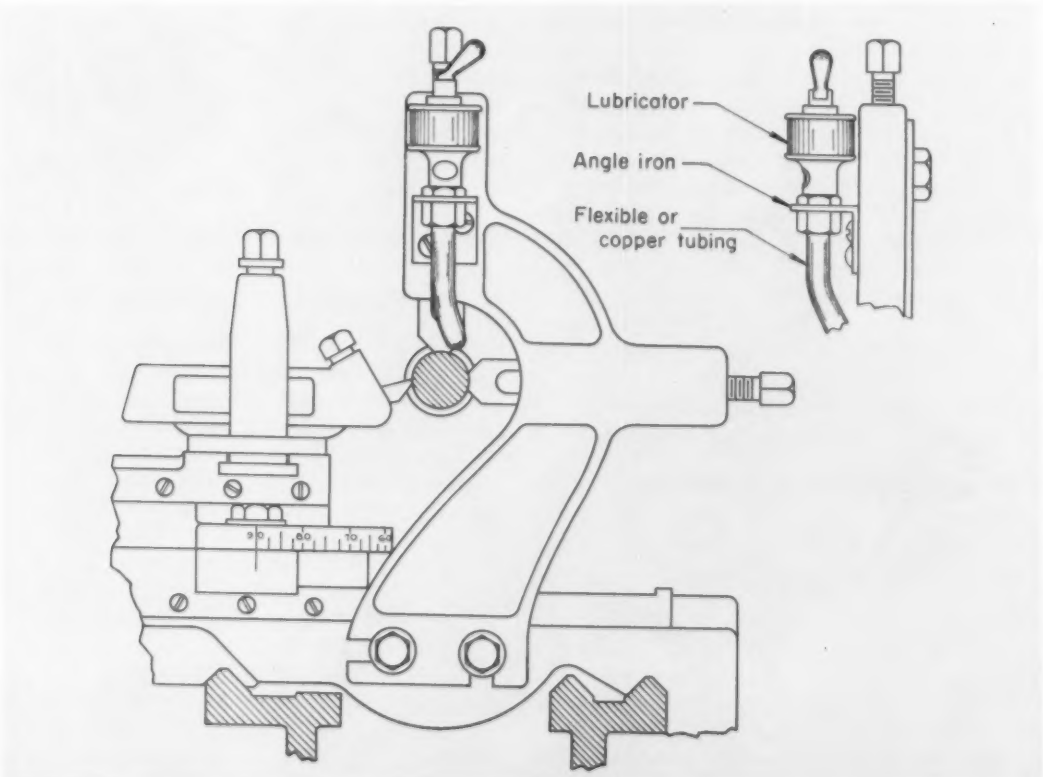
When a small number of parts are to be turned in a three-jaw chuck, and soft jaws are not available, a handy substitute can be made of soft iron pipe as shown. Small sections of pipe are cut off and clamped to the hardened jaws with capscrews. If the rings become damaged during operation of the machine, they can be turned and trued again to insure concentricity.

Detlef Schilling
Toronto, Can.

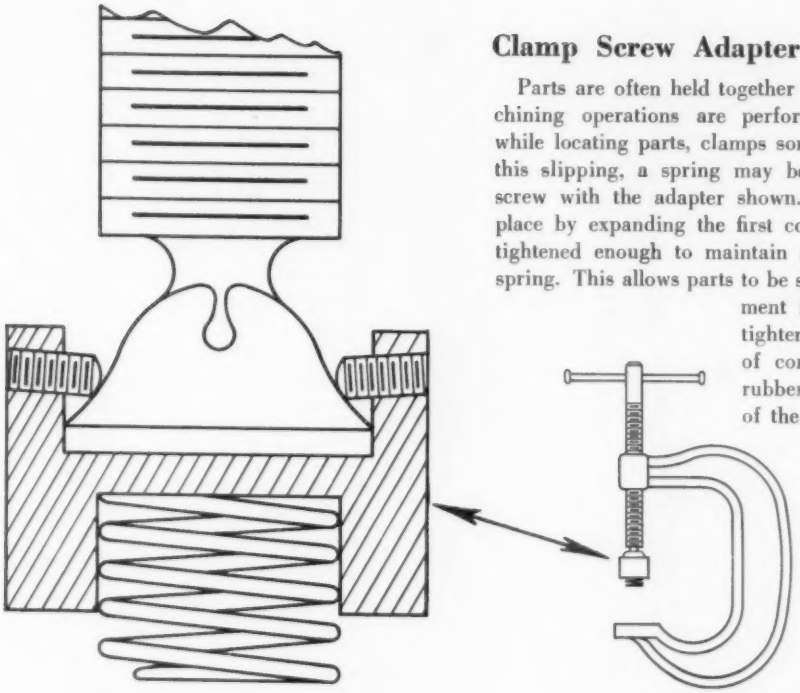
Lubricated Follower Rest

Heating due to friction and binding sometimes prevents high speeds in lathe operations where a follower rest is used. The lubricator illustrated can be mounted to most standard follower rests. A drip feed lubricator is supported by a piece of angle iron bolted to the side of the rest. A length of copper tubing is connected to the lubricator outlet to direct the flow of oil to the jaws and work. The constant flow of oil aids in turning long workpieces and allows higher machining speeds.

Harold Sedlik, Manchester, Conn.



Gadgets



Clamp Screw Adapter

Parts are often held together with C-clamps while machining operations are performed. During clamping, while locating parts, clamps sometimes slip. To prevent this slipping, a spring may be attached to the clamp screw with the adapter shown. The spring is held in place by expanding the first coil. In use, the clamp is tightened enough to maintain a slight pressure on the spring. This allows parts to be shifted. When final alignment is attained, the clamp is tightened. An alternate method of construction is the use of rubber in the adapter in place of the spring.

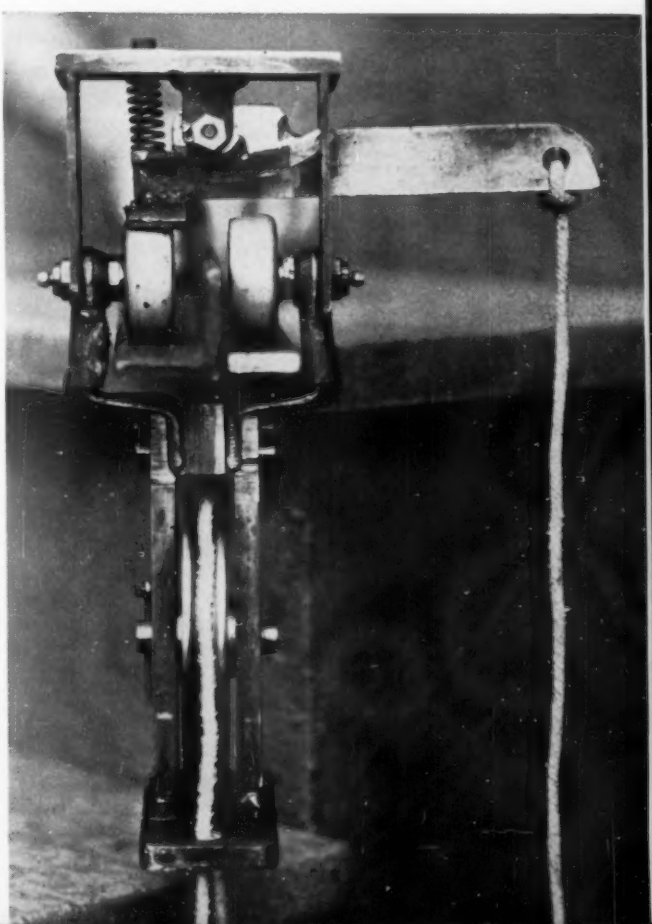
Ernest Jones
Bronx, N. Y.

Trolley Brake

Many factories employ trolleys to hold small pneumatic, hydraulic or other sorts of hand tools. The trolleys usually are mounted on single I-beam track. When the tracks go out of level due to settling of new buildings or other causes, the trolleys may travel to the lowest spot of the track of their own accord, requiring the operators to return them with each use.

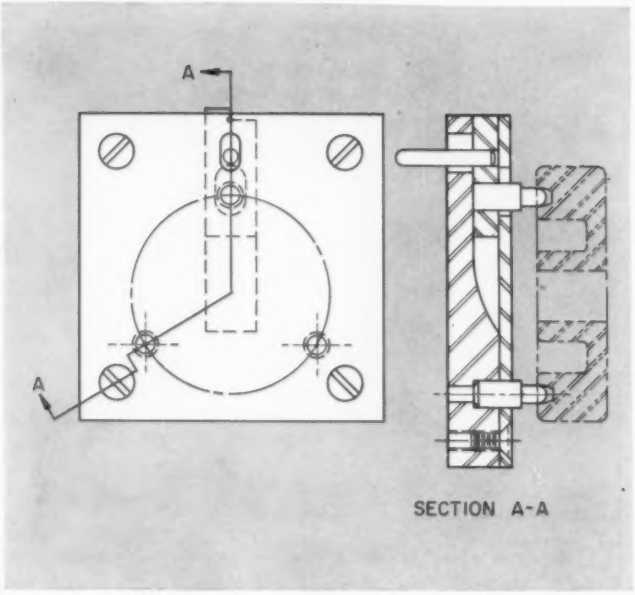
The trolley brake illustrated eliminates this problem. A spring-held lever applies continual pressure on the trolley wheel. A rubber pad is cemented on the contact portion of the lever. A rope on the other end is used by the operator to release the holding pressure for moving the trolley.

John Breen
Pittsburgh Chapter



Contributions for these pages describing short cuts for the tool engineer are welcome. Finished drawings are not necessary. Honorariums for accepted articles are sent upon publication.

Gadgets



Gage for Trepan Grooves

Gaging diameters of trepan grooves is a relatively common problem. The flush-pin gage illustrated can be applied to most grooves of this type. Variations of gage design can be used to adapt this basic principle to a variety of cases, including gaging a trepan groove on a shoulder.

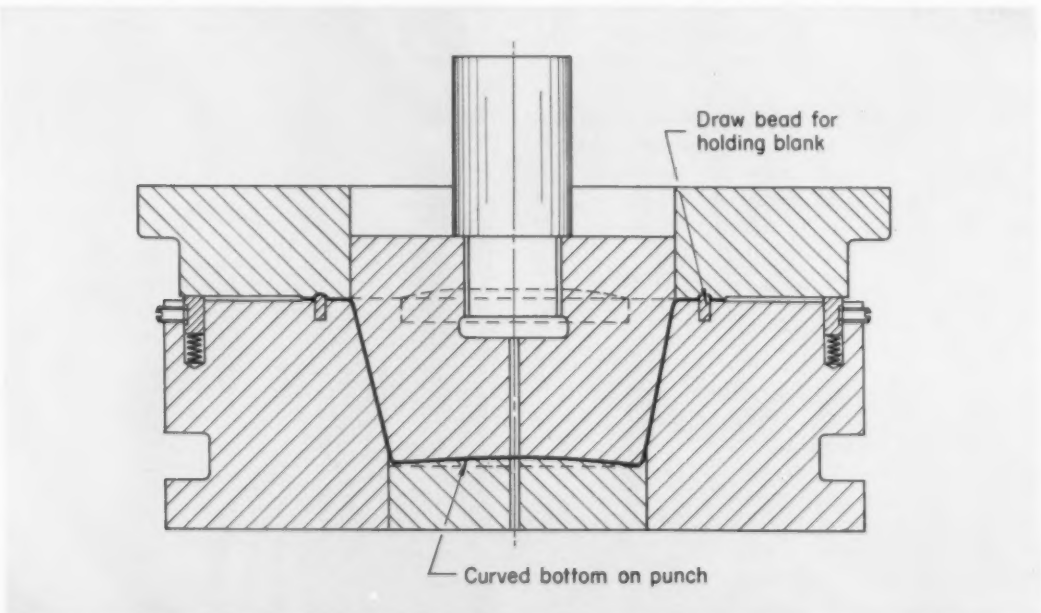
For straight or parallel sided grooves the three gage pins should have a tapered contact surface in place of the spherical radius used for a V-type groove as illustrated.

W. Russell Eldridge
Little Rhody Chapter

Drawing Die

Often when drawing deep rectangular boxes with sloping sides, the box bottoms do not come out flat and the sides may be crowned or curved. The die design illustrated eliminates these undesirable results and produces boxes of the required shape. Draw beads around the periphery of the rim help to hold the blank, which results in straight, flat sides. To prevent rounded bottoms, the lower die has a convex surface. Appropriate annealing between draws is necessary, depending on the depth of the draw.

Hjalmar Dahl, Upplands Vasby, Sweden



how temperature affects the MEASUREMENT of ALUMINUM

By J. C. Moody*
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Sandia Corp.
Albuquerque, N. M.

Better product and lower costs have been achieved when dimensional effects of temperature on workpiece have been considered. Each of seven major plants, manufacturing atomic ordnance, have reported outstanding results after witnessing tests reported in this article.

TODAY'S TIGHT TOLERANCES in the metalworking industry have placed new demands for measuring capabilities not only on the production lines, but also in the gage laboratories that support production facilities. Two of the greatest stumbling blocks in this pursuit for greater and greater accuracy in dimensional measurement work are temperature and transfer of heat. By contributing as they do to unstable thermal conditions, both in the pieces to be measured and in the dimensional reference standard, temperature and heat transfer create problems that can be resolved only by extreme care and precaution. In order to become more familiar with some of the thermal phenomena evident in this work and, thereby, to be the better able to combat these two trouble makers, experiments were devised and carried out to demonstrate thermal effects, *Fig.* 1.

An additional purpose of the experiments was to provide material for a demonstration of the effects of thermal phenomena on basic production line procedures. It was felt that when engineering and production personnel had a better understanding of the stringent temperature controls necessary to produce large aluminum parts to close precision, better products and decreased costs would result.

Measuring Principles: It is an interesting observation that a measuring instrument, when comparing materials of the same coefficient of linear expansion, indicates not the actual dimension of the feature being measured, but rather the dimension that the feature would have if the temperature of the piece were 68° F. That this is true is readily apparent from a review of the several factors involved.

First and foremost, the reference temperature for all dimensions has been internationally standardized at 68 F (20 C). Hence, the actual length of a reference standard has been established at 68 F. Second, when the coefficient of linear expansion is the same both for the standard and for the subject, then the amount that the length of the subject will change from nominal is the same as the amount the standard will change for the same degree of temperature shift from 68 F. To satisfy accurate measurement requirements in this instance, then, it is only important that thermal equalization of the two bodies exist.

When the subject and the standard have different coefficients of expansion, however, it is not sufficient simply to satisfy the demands of thermal equalization. The temperature of the subject and the standard must also be determined to a high

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Fig. 1. Typical test setup on the comparator to determine thermal effects on measurements.

degree of accuracy, and proper corrections must be applied to obtain accurate measurements. Here, then, in this area of different expansive coefficients lies the wider and more complete scope for study and demonstration.

Design Considerations: With these thoughts in mind, a small group of test pieces was designed and selected to demonstrate some of the principles involved in this type of work. The thermal demonstration package chosen, *Fig.* 2, consisted of three square blocks whose nominal lengths were 20 inches. One of the members was a square steel gage block without the center hole (Style 3). The other two, made from 6061-T6 aluminum, were of different cross sections—0.950 inch square in one instance, and 2 inches square in the other. Further differences between the aluminum members were introduced by anodizing the 0.950-inch-square piece to a dark gray color so that the rate of absorption and emission of radiant energy would be increased. The opposite absorption and emission effect was obtained on the 2-inch-square piece by grinding and polishing its sides to conditions of about 50 percent reflectivity. To facilitate a final lapping operation and also to have the same contact area on this member as on the other subjects, the ends of the 2-inch square aluminum piece were relieved to form a 0.950-inch square. This geometric consideration, it was felt, would reduce the magnitude of measurement uncertainties caused by errors such as out of parallelism, out of flatness, and other nonsymetric conditions of the workpiece.

The reference standard used was a 20-inch Hoke style steel gage block whose length had been certified by the National Bureau of Standards. Its cross section was 0.950 inch square.

Aluminum was selected for several reasons. Aluminum's 12×10^{-6} inches per degree Fahrenheit per inch of length coefficient of linear expansion is twice that of steel, and its thermal conductivity is nearly five times as great. This metal then would exaggerate the conditions under study and provide a better demonstration than would a less responsive material.

The 20-inch Style 3 steel gage block was identical (except for the center hole) to the 20-inch measuring reference; it was included in the experiment because, approaching as it would the same thermal conditions as the measuring reference, it would provide a contrast from the aluminum members of the study.

Fabrication of Test Pieces: Although several strict tolerances on various dimensions of the aluminum pieces were imposed on the machine shop, no serious difficulties were encountered in their fabrication. The parallelism tolerance of 0.0001 inch for the end faces was easily held in the finish grinding operation by conventional methods and equipment. But to successfully work to the 0.0001-inch-length tolerance on these two 20-inch aluminum pieces demanded stricter temperature control than that available in the grinding room.

The gage laboratory was called on to measure these pieces in their temperature-controlled area as the specified size was being approached. The grinding room brought the lengths of the two pieces to within several mils of 20 inches as indicated by their own measuring equipment. Then, the two pieces were stored overnight in the gage laboratory, and measurements were taken the next morning. The grinding room then removed the amount of excess stock as reported to them by the laboratory in units of 0.0001 inch. Thus they could get the size desired before the final lapping operation by accurately controlling the amount of material being removed. This operation was hardly size-control by automation, but it did give dimensional control to the degree wanted (0.0001 inch) with the use of existing production facilities and with a minimum of effort.

Finally the opposite measuring faces of the aluminum pieces were lapped to approach the degree of flatness, parallelism, and surface finish found in the measuring faces of gage blocks. As shown in *Fig.* 2, the supporting ends of the two aluminum

pieces were relieved to reduce the possibility of galling that could occur when these pieces would be slid on the steel anvil of the measuring device.

The Metrology of Aluminum: A 24-inch external comparator equipped with a transducer type pickup unit and an electronic amplifier, as shown in *Fig.* 1, was the measuring instrument used in the length tests. In the metrology laboratory the air temperature is normally maintained at 68 F within 0.2 deg. This strict control was in effect throughout the entire testing period. In order to satisfy the uniform temperature requirements previously outlined, the three test pieces and the reference standard were jacketed, as shown in *Fig.* 1. The purpose of the jackets was to reduce the effect of the extraneous radiant energy that is present in the measuring room. This energy comes through the walls, the ceiling, the floor, and from the overhead lights and other objects in the room and is difficult to control.

The jackets were sandwiches of double thicknesses of cotton batting between two layers of aluminum foil. Provisions were made to hold a mercury-in-glass thermometer with a window cut in the jacket at an appropriate place so that a reading could easily be made of the thermometer while jacketed. The thermometers were placed in the jackets so that the bulb made reasonable contact with one side of the test pieces at about the midpoint between the two end faces.

The thermometer location had been selected from special temperature studies. These studies indicated that, for all practical purposes, no discernible horizontal temperature gradient existed in any of the jacketed test pieces when put into their final test conditions. A vertical gradient was present to some degree, but it was demonstrated to be reasonably linear from one face to the other. Therefore, the assumption seemed reasonable that the temperature of the subjects at their midpoints on any one side represented the average temperature of the entire body.

Thermometers, mercury-in-glass type with graduations equivalent to 0.01 deg Cent, had been compared with a National Bureau of Standards certified platinum resistance thermometer. A correction was established for the working temperature of 20 C. It was estimated that the uncertainties of these corrected values did not exceed 0.01 deg. To further reduce the amount of extraneous energy that ultimately reached the test block bodies, the entire comparator was shielded overhead and on three sides by corrugated cardboard outerfaced with aluminum foil.

Certain other precautions were necessitated because the level of extraneous energy present in the measuring room varied significantly during the span of the workday. The subject to be tested and the 20-inch reference were prepared and set up ready for measurement the day before the workday in which the actual measurements were to be made. Also, all lights were left off during the night and were not turned on again until after the measurement had been taken at the start of the workday. The one window in the room was shielded to exclude light from any external source. The actual read-outs during the measuring operations were made by aid of a flashlight. All this was to take advantage of the point of most stable thermal conditions which was at the start of the workday; and meant that only one comparison could be made per day.

A typical test setup, but with the "thermal cabana" removed, is shown in *Fig.* 1. The 2 x 2-

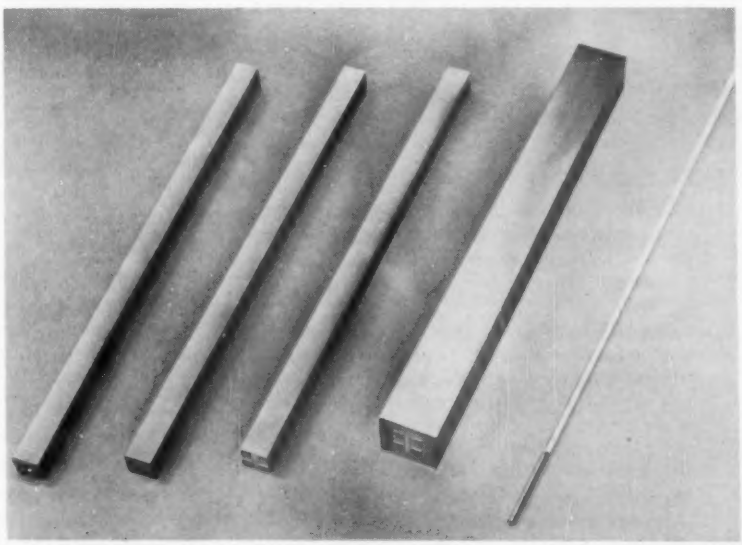

Fig. 2. Test pieces and reference (left) used in thermal-measurement studies.

Table 1—Tabulation of Dimensional and Temperature Differences

Blocks Compared	1st Set of Readings	2nd Set of Readings	3rd Set of Readings	Mean
	Dimensional Difference (microinch)	(microinch)	(microinch)	(microinch)
$S < R$	78	76	77	77
$A_S < R$	985	991	997	991
$A_L < R$	330	335	339	335
$A_S < A_L$	657	659	667	661
	Temperature Difference (deg C)	(deg C)	(deg C)	(deg C)
$S > R$	0.014	0.016	0.012	0.014
$A_S > R$	0.054	0.049	0.044	0.049
$A_L > R$	0.084	0.094	0.084	0.087
$A_S < A_L$	0.031	0.021	0.021	0.024

Legend: S = 20-inch Style 3 steel gage block
A_S = 20-inch aluminum block, 0.950 inch square
A_L = 20-inch aluminum block, 2 inches square
R = 20-inch Style 2 steel gage block; Reference Standard

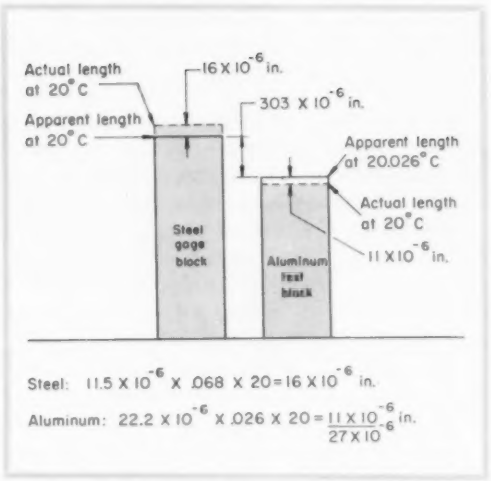

Fig. 3. Dimensional effect of different temperatures on aluminum workpiece and steel gage block.

inch aluminum test piece is in the center of the anvil and directly under the pickup unit. For the sake of uniformity the gaging point on all three test pieces is the center of the top surface. The 20-inch reference standard is also on the anvil but to one side. The apparent differences in length and temperature of the test piece and the standard were read and noted from the electronic amplifier and the thermometers. These differences were converted to actual differences by applying the necessary corrections and are shown in TABLE 1.

The complete test consisted of comparing the Style 3 steel gage block to the reference standard; comparing the 0.950-inch-square and the 2-inch-square aluminum pieces to the reference standard; and finally comparing the 0.950-inch-square aluminum block to the 2-inch-square aluminum blocks. Because the significance of one reading can be questionable, a set of three readings was obtained for each of these four comparisons. In other words, each comparison was made on three occasions.

From the actual results of these tests, which are expressed in numbers and are shown in capsule form in the table, several interesting observations may be made regarding these events:

1. A condition of fairly uniform temperatures was obtained between the two steel blocks.
2. Good repeatability of the three readings on the dimensional difference between the two steel blocks resulted.
3. In the comparison of the aluminum pieces with the steel reference, the magnitude of both the temperature and the dimensional differences were reasonably well duplicated. Although greater than those found in the steel-to-steel comparisons, the spread between any values in the three sets of readings was small—12 microinches and 0.01 deg Cent or less.
4. The temperature differentials between the aluminum pieces and the steel reference is greater than the differences between the two steel blocks by a factor of 3 in the case of the smaller aluminum block, and by a factor of 6 in the case of the larger.
5. In the comparison of the aluminum blocks with each other, a relatively small temperature differential of 0.024 deg Cent occurred which approached the low 0.014 deg differential value found in the steel-to-steel comparison results.
6. Mathematically, the dimensional difference between the two aluminum pieces as established by comparing them to the same reference equals the difference as established by comparing one to the other. That these values are in agreement within five microinches ($991 - 335 = 656$, as compared to 661) does much to strengthen the degree of confidence that can be placed on these results.

Interestingly enough, throughout all of these tests, the temperatures of the steel pieces coincided very nearly with the temperature of the surrounding air in the test area whereas the temperatures of the aluminum pieces were always higher.

The actual dimensional differences tabulated are obtained by applying several corrections to the observed differences. To better explain this process in its entirety, the deviation of one differential—the 335-microinch differential—is traced.

The difference in length between the large aluminum piece and the steel reference standard was 303×10^{-6} inches as observed from the meter of the electronic amplifier. The accuracy of this meter reading was checked by master gage blocks. A correction factor of plus 9×10^{-6} inches was necessary to compensate for this inaccuracy.

The mercury-in-glass thermometer indicated the temperatures of the large aluminum piece and the steel reference standard to be 20.026 C and 19.932 C, respectively. This meant that the true length of the steel reference was longer than the observed length and that the true length of the aluminum test

piece was shorter than its observed length. The apparent difference in length, then, was further corrected by the sum of these two derived values. This correction was 27×10^{-6} inches; its derivation is shown in *Fig.* 3. The coefficients of linear expansion used were 11.5×10^{-6} inches per inch of length per deg Cent for steel in accordance with the National Bureau of Standards and 22.2×10^{-6} inches per inch of length per deg Cent for 61T6 aluminum in accordance with *Alcoa Structural Handbook*, 1955.

Another possible source of systematic error in precision measurement work results from the influence of the elasticity of all solid bodies. When measurements are being made under conditions of physical contact, the pressure of the feeler on the object being measured causes a deformation of both the feeler and the object. In the case of an object of parallel sides between parallel plane feelers, this deformation is negligible; but in the case of a spherical feeler acting on a flat surface, the amount of deformation is measurable. Also, if the materials being compared have different physical properties, then the penetration of the feeler into one material is of a different order than that which occurs in the other, *Fig.* 4. This difference can be calculated, and when its magnitude has been determined, it becomes a correction factor. (The solution of this problem of the total movement of two contacting bodies being acted on by a force is given in *Advanced Mechanics of Materials* by Fred B. Seely and James O. Smith, Second Edition, Chapter 11.)

This relationship in these measurements is shown in TABLE 2. Here, the $\frac{5}{32}$-inch-diameter steel stylus under a measuring pressure of 2.1 ounces entered below the flat surface of the 20-inch steel reference standard to a depth of 7.77×10^{-6} inches. Its penetration below the surface of the aluminum-test piece was 12.03×10^{-6} inches. Difference of 4×10^{-6} inches was the correction factor.

After these three corrections had been computed, and proper signs for them ascertained, their algebraic sum was added to the apparent difference to obtain the actual difference. Thus, in units of 1×10^{-6} $(27 + 9 - 4) + 303 = 335$ inches. This is the actual difference and is entered in TABLE 1.

As indicated, the dimensional measuring reference used in these tests was a 20-inch steel Hoke style gage block. Its length has been certified by the National Bureau of Standards to be 20.000 055 inches. The individual length of each test piece was finally established by subtracting the actual difference, listed in TABLE 1 from this reference length of 20.000 055 inches and is shown in TABLE 2.

Results of Studies: The results of this experiment emphasize some of the important considerations that are so vital in the quest for precision in dimensional measurement work. Known physical phenomena have been verified, and this should lead to a better understanding of the relationship that exists between thermal instability and size change. Various techniques and their adoption to improve thermal stability and equalization between the workpiece and the measuring reference have been suggested by these demonstrations. Because of the knowledge gained from these studies, a higher degree of confidence can exist in the measurement of materials having a coefficient of linear expansion significantly different from that of steel.

Significance of Thermal Studies: After the tests and demonstrations were completed, the test pieces were sent to seven major manufacturers of atomic ordnance who produce many large aluminum parts with close tolerance requirements. A typical example is a 50-inch hole location dimension in an aluminum component that is held to a 0.001-inch tolerance. In the gage laboratories at these various plants, the test pieces were set up and demonstrations similar to those outlined were performed. Personnel from many divisions of the plants—the gage laboratory, inspection, design and tool engineering, etc.—were brought in to witness these tests and to observe the size changes that would occur from a minute change in the controlled conditions. In the demonstrations, the test pieces were measured both with and without their insulating jackets, in order to record any significant differences resulting from the use of the jackets, and the pieces were measured periodically throughout the day. The considerable differences in measurement were readily apparent to the witnesses. At the completion of the tests, each participant reported what had been gained from engaging in this aluminum measure-

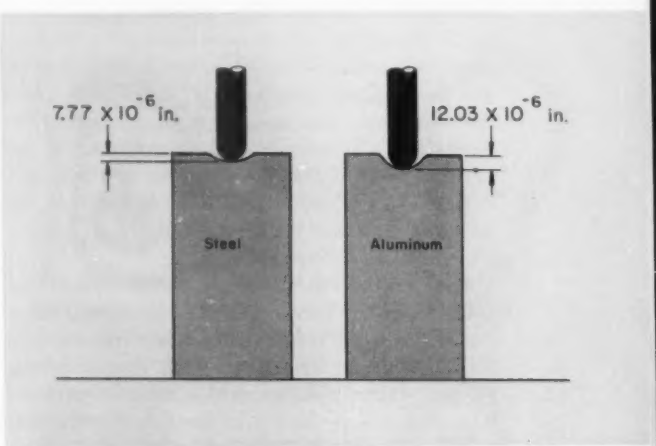

Fig. 4. Penetration of feeler due to differing elastic properties of steel and aluminum materials.

Table 2—Final Length Test Results

Test Block (type)	Length (inches at 68 F)
Steel	20.000 055 – 0.000 077 = 19.999 078
Aluminum (small sample)	20.000 055 – 0.000 991 = 19.999 064
Aluminum (large sample)	20.000 055 – 0.000 335 = 19.999 720

ment activity. Typical is this excerpt from one of these reports.

1. Gage laboratory personnel now have a better understanding of the precautionary measures that must be taken to obtain precise measurements on gage features and of why these precautions are necessary. The result—better gage control.
2. Shop inspectors now know the importance of determining the temperature of both the gage and the part. In the shop, steel gages to check steel parts and steel gages to check aluminum parts are used. Aluminum gages to check aluminum parts and aluminum gages to check steel parts are also used. These various material combinations between the gages and the parts make it mandatory in many instances that the temperature differentials between the gage and the part be determined. Temperature checking devices have always been available, but now the importance of using them is more fully appreciated. They are now being used, and proper corrections are being made.
3. Formerly many parts that were made and accepted during the heat of the summer would suddenly not function or fit properly when the cooler weather of fall arrived. Temperatures had been neglected. Also disagreements between shifts on what was an acceptable product were not uncommon. Again, temperature had not been considered.
4. Design and tool engineers are now taking a closer look at materials and tolerances for product, tools, and gages. Where experience is indicating that product tolerances are incompatible with the temperature conditions in the shop, these tolerances are being changed to a more realistic level. In the several cases of weapon components where physical phenomena will not allow a relaxed tolerance, production of these parts has been moved into temperature-controlled areas.

Demonstrations with the temperature-sensitive aluminum bars at participating plants have generated widespread interest in the relationship between temperature and dimensional control. Appreciation of these affects has resulted in application of the principles leading to better product and lower cost.

Testing Spring Materials

ELEVATED TEMPERATURES attained in the power plants of modern aircraft have developed a need for improved spring materials; however, basic data on the thermoelastic properties of metals and alloys must first be accumulated before these materials can be designed. To provide such information, the National Bureau of Standards has devised two techniques, one utilizing a pendulum assembly to test wire specimens, and the other a sonic vibration technique to test solid materials.

The equipment used in the pendulum method consists of an oven, photoelectric cell and lamp, timer, counter and electronic temperature recorder. A frame about the oven supports a three-foot-long, 0.5-inch diameter steel rod that extends vertically through a hole in the top of the oven into the heat chamber. The wire specimen is suspended from a chuck on the lower end of the rod. Another chuck, firmly fixed on a six-inch diameter brass disk, grips the lower end of the specimen. When a small amount of twist is applied with a starting arm fitted to the upper portion of the rod, the pendulum oscillates about the axis of the specimen.

The photoelectric cell and lamp, mounted just outside the rear of the oven, are aligned with two holes in the oven wall. Once in each half-cycle of oscillation, light from the lamp strikes a small mirror attached to the assembly and is reflected to the cell.

Thus energized, the cell operates the counter until a predetermined number of oscillations is recorded. The shear modulus of the wire is then computed from the resonant frequency derived for the specimen and the dimensions and masses of the pendulum assembly. Frequency range of this test is from a fraction of a cycle to 10 cycles per second. Test temperatures up to 525 F are shown on the temperature recorder.

In the sonic vibration method, either a rod or a rectangular prismatic bar specimen, approximately six inches long, is suspended from an electromagnetic driver by two asbestos strings and inclosed in a furnace that operates at temperatures up to 1000 F.

The specimen is excited to its resonant frequency by the driver and a variable audio oscillator. A crystal pickup detects the vibrations, which are shown as an expanded wave on a cathode ray oscilloscope. The frequency of the oscillator is then adjusted to the frequency of the specimen, indicated by the amplitude of the oscilloscope trace, and this adjusted frequency is measured with an electronic events-per unit-time counter.

From the measurements thus obtained, Young's modulus can be computed for rod specimens. In using the apparatus for tests on rectangular prismatic bar specimens, the prisms can be made to vibrate either in tension or torsion, so that both Young's modulus and the shear modulus may be determined without changing the mode of suspension.

COMBINED OPERATIONS

key to cost reduction

By L. Hoffman*
Tool Engineer
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Eliminating time-consuming steps in manufacturing—such as transfers from machine to machine—and performing several operations simultaneously are important first steps in any methods improvement program.

COST REDUCTION need not involve large expenditures for new equipment. Often means for cost reduction are readily apparent from a careful analysis of existing operations. It may be possible that the capacity of available equipment is not being fully utilized. In such cases the possibility of performing several operations on one machine should be carefully studied. Spectacular savings may result.

This was the case at IBM, where special tooling, *Fig.* 1, has been utilized to permit several milling operations to be performed simultaneously. The part, *Fig.* 2, is a Meehanite casting, heat-treated and drawn to a 149-183 Brinnel hardness and sand blasted to remove scale prior to machining. The operations are as follows:

1. Rough turn on chucker
2. Finish turn on chucker
3. Mill 64-degree rake angle on two sides
4. Drill, ream, tap and countersink
5. Ball mill groove, 360 degrees
6. Mill form and part to make two pieces
7. Horizontal mill 4-degree angle on individual pieces
8. Mill slots
9. Deburr completely.

For the purpose of methods analysis, these operations were listed on the type of form shown in *Fig.* 3, with other pertinent data. The data includes the purpose of each operation, its importance to part function or assembly, type of equipment used and so on.

A study of the sheet showed that operations 1, 2, 3, 6, and 7 were the best places to seek methods improvement because of dimensional leeway and their relationship to the machining sequence. The relative times required for the various operations were also charted. It was readily seen that operation 7 required a considerable amount of time. The purpose of operation 7 was merely to provide clearance for final assembly; functionally this clearance was unimportant. For this reason, operation 7 was selected for detailed methods improvement study. This was the first step in analysis.

The next question was, "Can operation 7 be com-

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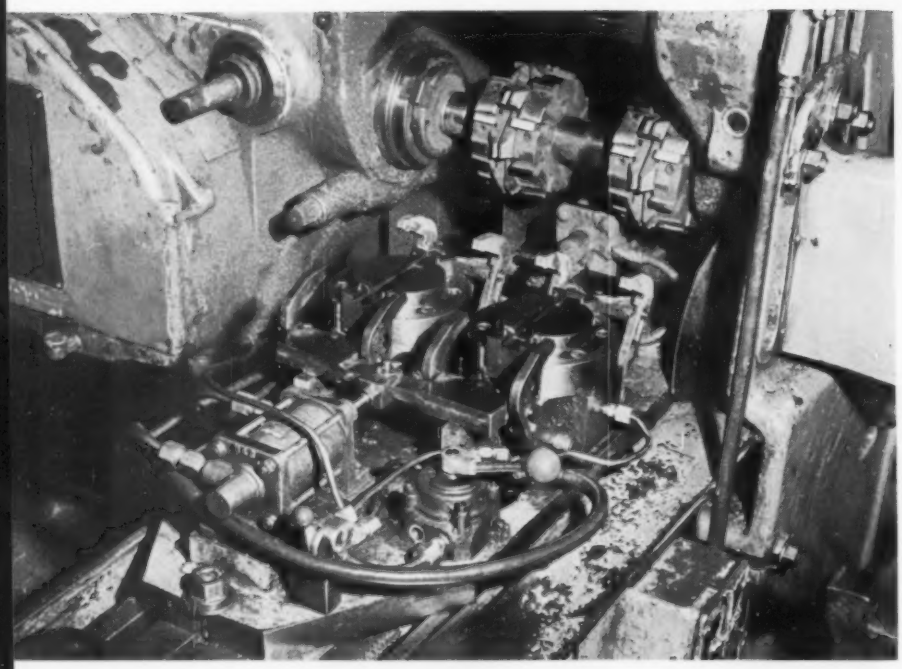


Fig. 1. Two milling operations have been successfully combined on one machine. This eliminates the need for a second machine.

bined successfully with another operation and, if so, how can this be done?" One suggested method was to combine operations 6 and 7 into one broaching operation. An objection to broaching was that the relatively weak casting wall might fracture under broaching stresses.

Another possibility that was investigated was to acquire a new milling machine and perform operations 6 and 7 in one-gang-milling operation. Quotations on a new machine showed that it would pay for itself in less than two years.

The new machine was not purchased because further study showed that the existing machine had sufficient capacity to permit operations 6 and 7 to be combined, utilizing new tooling. In retooling, it was necessary to add two interlocking four-degree angle cutters to the existing gang cutter. The same cutter-gang arbor was adequate for the increase in machine load, but new spacers were necessary for changed center distances.

Whether or not the retooling would be compatible with the machine was also studied. The No.

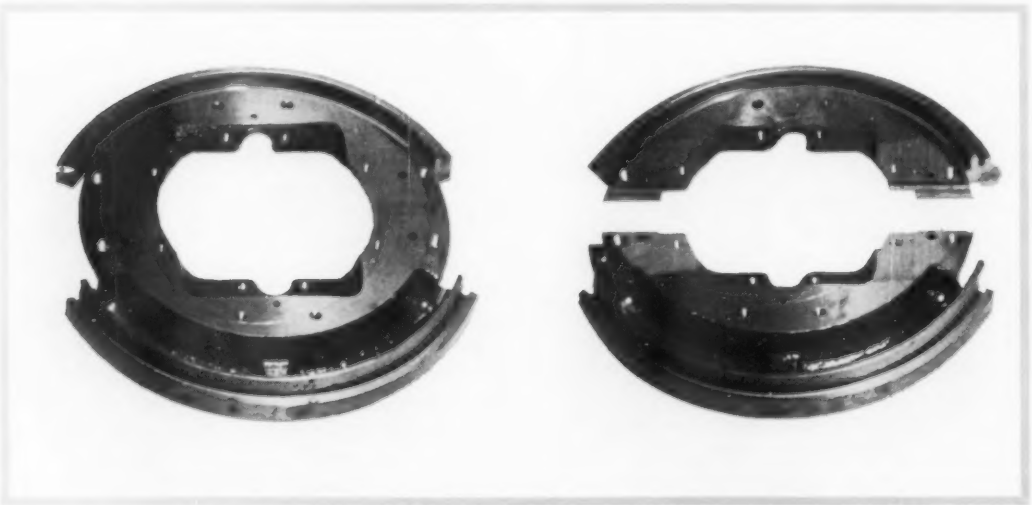
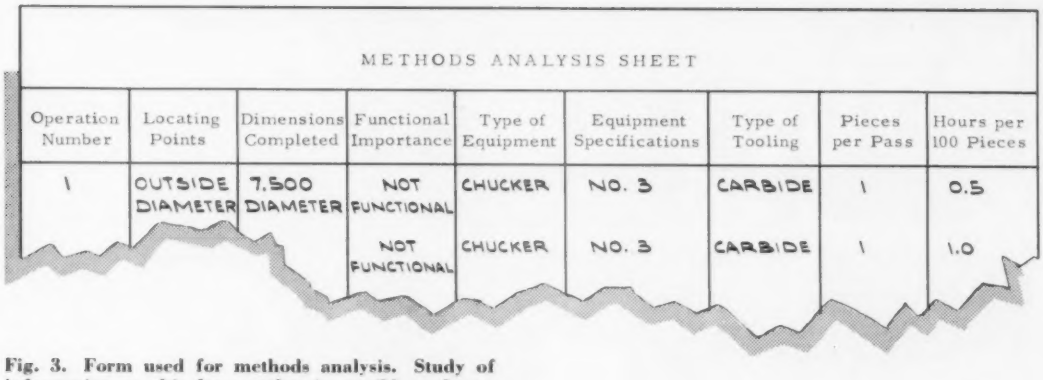


Fig. 2. Partially machined part (left) is form milled and parted on one machine. A four-degree assembly clearance is also machined simultaneously.



METHODS ANALYSIS SHEET

Operation Number	Locating Points	Dimensions Completed	Functional Importance	Type of Equipment	Equipment Specifications	Type of Tooling	Pieces per Pass	Hours per 100 Pieces
1	OUTSIDE DIAMETER	7.500 DIAMETER	NOT FUNCTIONAL	CHUCKER	NO. 3	CARBIDE	1	0.5
			NOT FUNCTIONAL	CHUCKER	NO. 3	CARBIDE	1	1.0

Fig. 3. Form used for methods analysis. Study of information on this form makes it possible to locate operations where methods improvement may be possible and fruitful in terms of reduced costs.

12 Brown & Sharpe used for operation 6 had a somewhat narrow table, but by allowing one inch overhang on each side of the table the new milling fixture could be used. Travel and feed remained unchanged.

The decision to retool was made on the basis of the savings realized by completely eliminating the separate milling operation for operation 7. No additional time was required for operation 6: setup time, loading and unloading time, and quality remained the same. Indirect savings were realized through the release of equipment for other work, space savings, storage savings and reduced overhead.

From this example it can be seen that combining operations can be a most effective way of reducing costs. By analyzing the product itself, its relationship to an assembly, the equipment used to machine the product and the tooling—and applying the results—real savings can be made.

Cans Produced by Impact Extrusion

A COMPLETELY AUTOMATED LINE for the production of impact extruded aluminum cans has been developed by Aluminum International at a cost of more than $3.5 million. According to them, the advantage of aluminum as a material for beer cans is its compatibility with beer.

Can bodies are made from 2S aluminum 2.5 in. in diameter by 0.125 in. thick. Automatic hopper feed delivers the blanks to the female die in a new high-speed aluminum impact extrusion press developed by the E. W. Bliss Co. Output of the press is an eleven-ounce beer can whose wall thickness is 0.010 in. and whose ribbed reinforced bottom is 0.025 in. thick.

The press operated at its production speed of 120 cans per minute when demonstrated at the Bliss plant recently. Such a high rate of operation is unusual. Twice a second a blank is fed, impact extruded, and ejected.

The ability to operate at these high rates was brought about by a new approach to the design of the press drive. Impact extrusion presses designed to date have used knuckle-joint actions which give great power and dwell at the bottom stroke. By the same token, the knuckle-joint action has a rapid approach and rapid return. This characteristic of knuckle-joint actions creates problems in designing automatic feeds and ejection systems.

In the new press, an eccentric crank action is used which provides higher impact speed and allows more time for the feed and ejection systems to function. The automatic hopper feed is directly connected to the press drive to assure accurate timing. An additional advantage of the press design is that the small slugs used should help makers of aluminum cans to save storage space and shipping charges.

The press was designed and built for Aluminum International, Inc., and two of them will be installed in the fully automated can line at the Adolph Coors Co. brewery in Golden, Colorado.

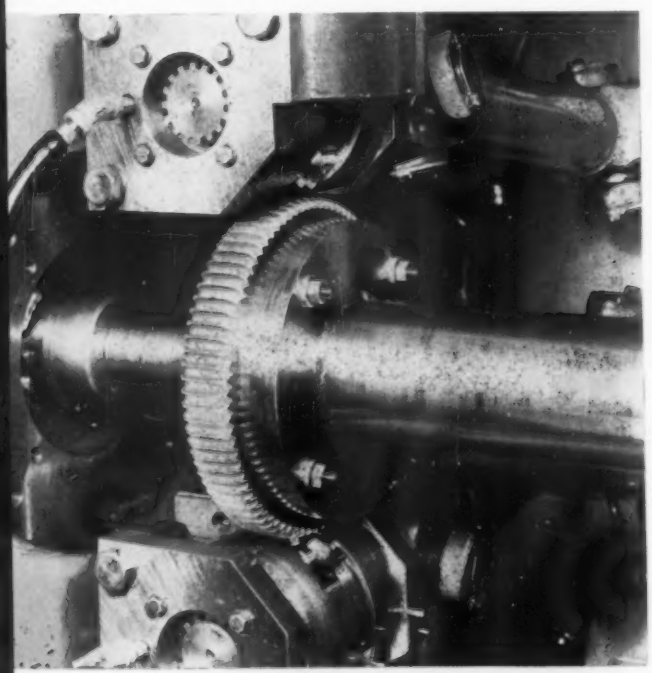
The new press, together with a continuous strip casting method previously developed by Aluminum International makes the aluminum can competitive with conventional three-piece steel can lines equipped with the latest modern equipment.

designed for

PRODUCTION

Machine Roll Forms Gear Teeth

Planetary rollers, revolving into ductile metal blanks, cold form gears in the Grob gear rolling machine illustrated. Motion of the rollers is synchronized with the indexing of the workpiece. When rolling gears with an even number of teeth, diametrically opposite rollers neutralize opposing swaging forces. In this way, the gear blank indexes one tooth for each cycle of the form rollers. Cycle frequency is in a range of 800 to 3500 cps.

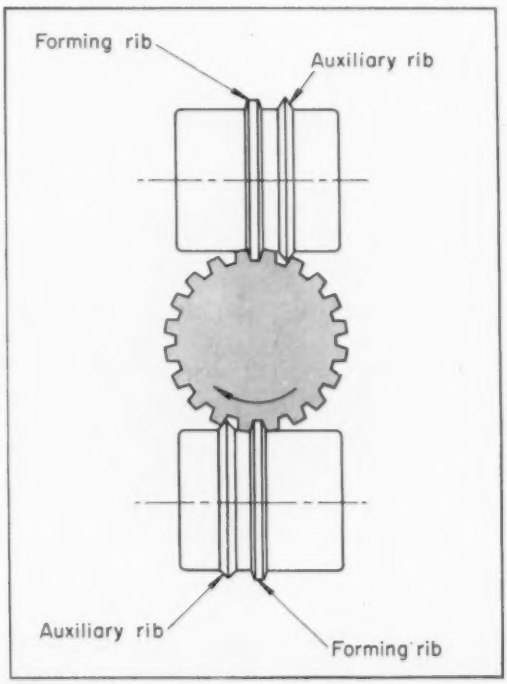


GENERATION of gear teeth by revolving rollers. Rotors, top and bottom, are synchronized to workpiece spindle by timing gear.

Opposing rollers are identical in design even when gears with an odd number of teeth are rolled. Each roller has an auxiliary pilot rib in addition to a forming rib which creates the tooth contour. Functions of the auxiliary rib are to pilot the blank and support the finished tooth.

Tool rotors which carry the rollers are driven by universal joints and are synchronized with the work spindle by timing gears. Change gears provide for indexing to roll the required number of teeth in the gear.

Principal features of cold forming are its speed of production and high strength resulting from cold working and grain flow in the tooth sections. Time and cost requirements are 1/10 to 1/5 that of conventional machining.



CROSS SECTION of rollers and workpiece. Planetary rollers strike gear blank simultaneously on opposite sides from opposite directions for a gear having an even number of teeth. Pilot tooth corrects indexing.

Furnace Flattens Steel Sheets

Steel sheets are flattened during tempering or precipitation-hardening operations in a furnace designed by Waltz Furnace Co. of Cincinnati, Ohio. Flattening is accomplished by subjecting the sheets to die pressure within the furnace. Two cast-iron dies perform the operation. The upper die, actuated by a Vickers hydraulic unit does the work, the lower die being stationary.

Flattening ability of the furnace gives it widespread applications particularly in aircraft work. Materials such as 17-7 PH are flattened for critical applications such as skins for wing sections.

Copper-Alloy Nozzle for Metallizing Torch

A copper alloy nozzle has made the use of high-temperature metallizing practical. Manufactured by Metallizing Engineering Co., Inc., of Westbury, L. I., the torch is designed to metal-spray refractory materials whose melting points range as high as 4748 F. Temperatures required to melt and spray the materials are produced by plasma, a disassociated, ionized gas, which recombines in the nozzle to produce temperatures as high as 30,000 F.

Tungsten and ceramics used as nozzle material in initial experiments with plasma failed to stand up under prolonged use. The copper alloy now used has high thermal conductivity, enabling it to transfer heat rapidly to water lines in the torch.

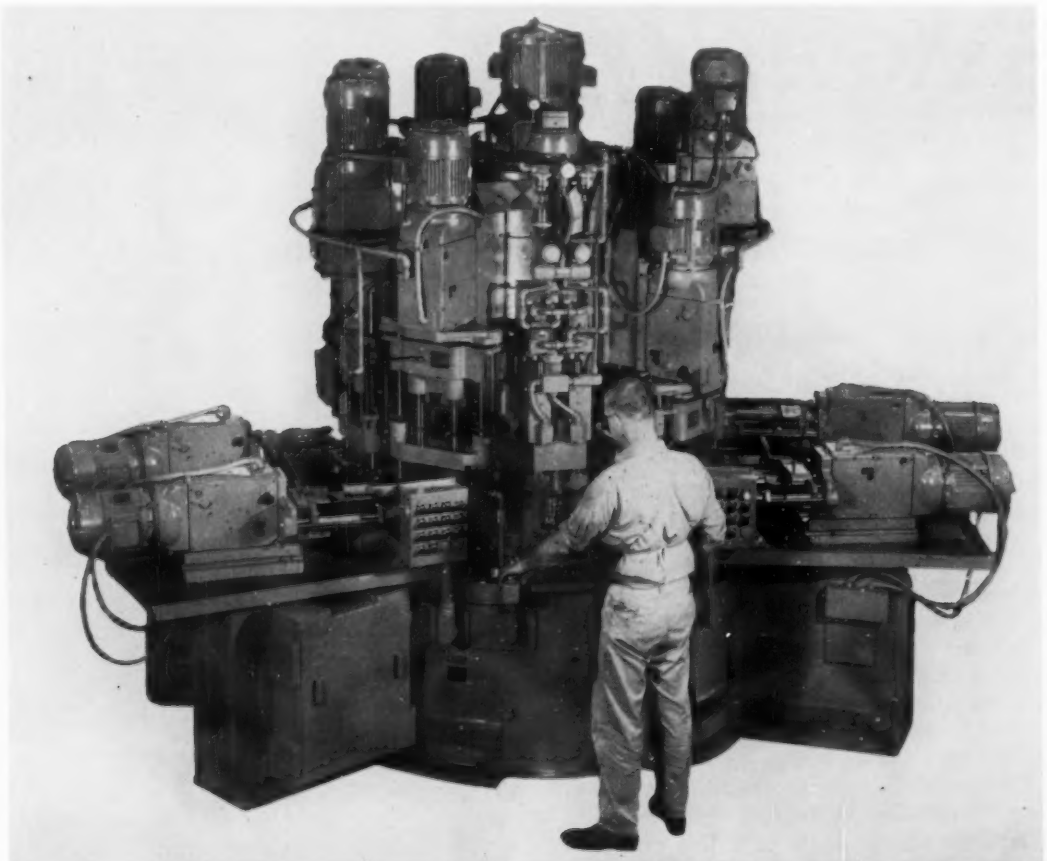
Difficulties in introducing the metal to the plasma flame were resolved by suspending particles of the spray material in a carrier gas. This gas is fed directly into the plasma flame in the nozzle. Picked up and vaporized by the flame, particles are carried to the target material at speeds up to 34,000 fps.

Automatic Machine Drills Valve Bodies

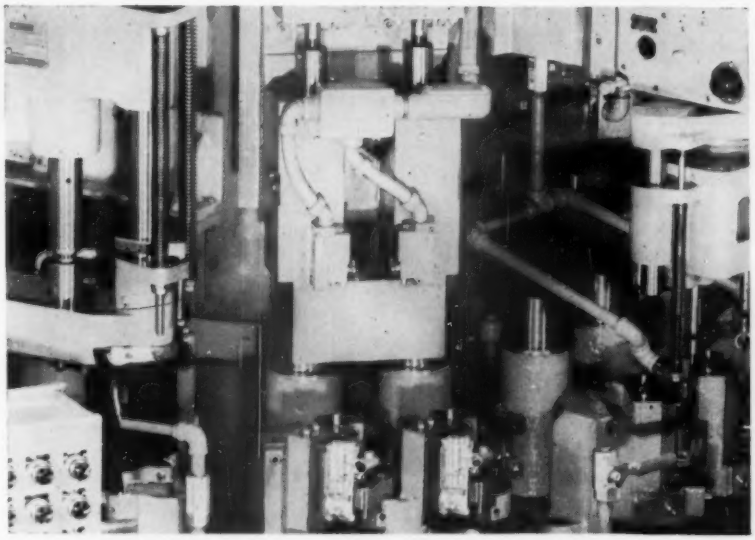
Multiple angle drilling operations are performed on two valve bodies at each station of an automatic drilling machine developed by Kingsbury Machine Tool Co. Designed with 30 spindles, the machine performs 15 operations on each part at a production rate of 190 pieces per hour.

To drill holes in three planes, four horizontal units are mounted at angles of 45 deg to radial center lines of the machine and eight units are mounted vertically. Fixtures holding the work at a 45-deg angle enable the horizontal units to line ream holes in planes 90 deg apart.

Nine double-chucking fixtures mounted on a 60-inch index table hold the parts. Cam-actuated clamps on the fixtures automatically release the work at the end of the cycle.

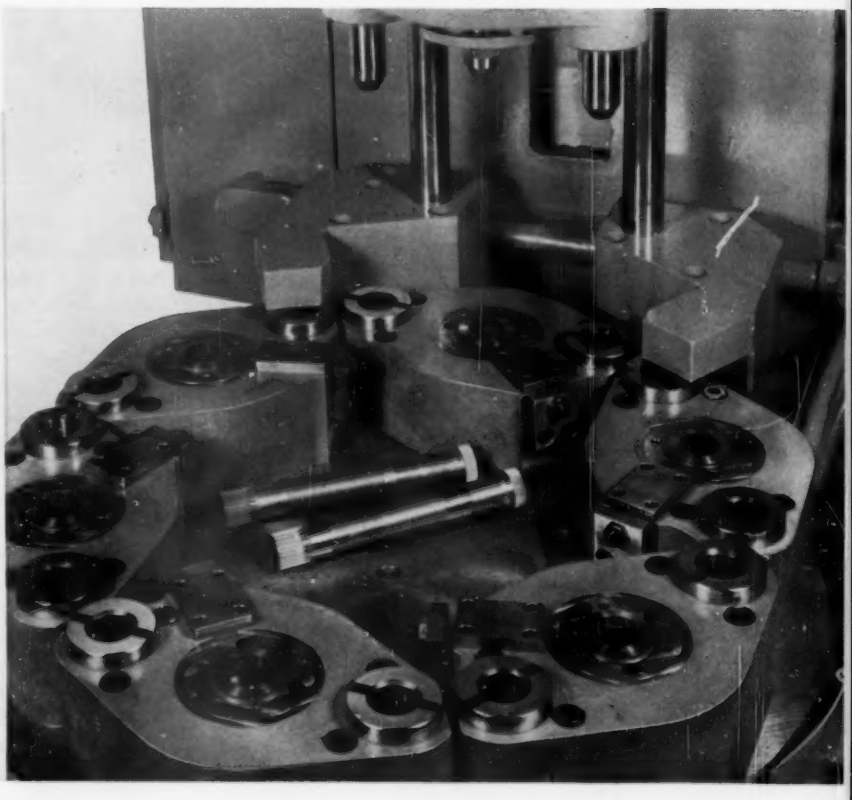


DRILLING MACHINE in operation. Control panels provide operator with centralized control of machine functions. Horizontal units enable machine to drill and ream holes in workpiece from three different angles.



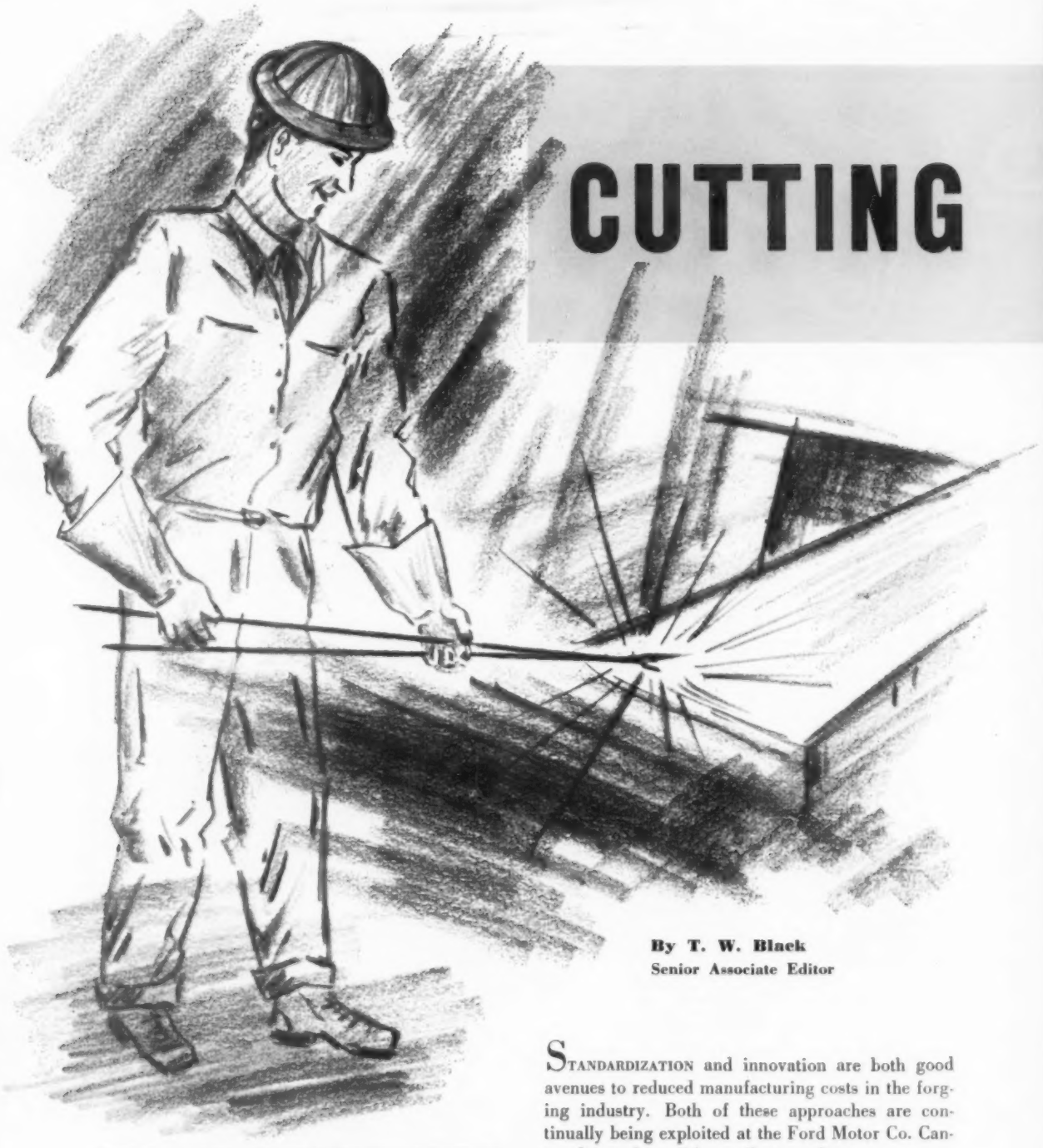
DOUBLE-CHUCKING FIXTURES hold valve bodies at 45 deg to machine center line. Clamping and unclamping of work is automatic.

External Serrations Broached Progressively



External serrations on transmission shafts are broached progressively by six dies mounted on the indexing table of a hydraulic broaching press. The dies, divided into two sets of three, have 65 teeth each. A total of 130 serrations is obtained by radially offsetting every other die to an angle equal to one-half the tooth pitch. To produce the sharp serrations required, inside die diameters increase in increments of 0.010 inch. The broaching press, manufactured by Detroit Broach & Machine Co., has a production capacity of 151 pieces per hour at an efficiency of 80 percent. Speed is approximately 25 surface fpm.

CUTTING



By T. W. Black
Senior Associate Editor

Die replacement is one of the major costs in high-production forging operations. A number of innovations at Ford Motor Co. have lengthened die life and contributed significantly to over-all efficiency.

STANDARDIZATION and innovation are both good avenues to reduced manufacturing costs in the forging industry. Both of these approaches are continually being exploited at the Ford Motor Co. Canton forge plant with excellent results.

Materials: Standardization starts with product materials in this plant. Some 70 different part designs are produced, ranging in weight from one-half pound to more than 25 pounds. The parts include gear blanks of all kinds, front wheel spindles, transmission output shafts, connecting rod caps and the like. About 600 tons of metal is processed daily.

Despite the relatively large number of product designs, only a few steels are used. Five of these

FORGING COSTS

are: SAE 1022, 1038, 5132, 5140 and 8620. The advantages of using only a few types of product materials are, of course, inventory simplification and the ability to buy steels of any one type in large quantities. From the standpoint of processing, the need of tool designers and others to become familiar with only a limited number of product materials is also an advantage.

Standardization has also been extended to punch and die materials. Steels of the SAE 4140 and H12 types are most commonly used for hot-working operations in the plant. Hot trim sections are usually of SAE 1045 steel—a material that has sufficient shock resistance to withstand trimming conditions. All surfaces exposed to wear are faced with a welded-on coating of Stellite. Results in terms of die life are extremely satisfactory.

An innovation—nitriding of dies—has doubled, and in some cases tripled, the life of hot-work dies. Nitriding has been particularly successful with upsetting and swaging dies. The disassociated-ammonia process is used, producing a 0.009-0.010-inch thick case. Die life improvement can amount to 10,000-20,000 hits. Nitriding is not suitable for hammer dies, since the glass-like case is extremely brittle and cannot withstand heavy shock. Experiments shows that flashing a coating of tungsten carbide onto the wear surfaces of hot-work dies, another innovation, results in a five-fold life improvement.

Most of the product materials used in the plant are gas-heated to 2250 F prior to forging. At this temperature, there is a tendency toward formation of excessive scale, which can have an adverse effect on die life. Ford tool engineers have found that careful control of heating to minimize scale pays in terms of better die life.

Cold Forming: Ford engineers have applied cold-forming methods to several production parts. This method is much more economical than hot forging for some parts. The cost of installing and maintaining heating equipment is, of course, eliminated. Materials handling is simplified and working conditions are improved, due to the absence of heat and scale. Also, cold forming lends itself to automatic operation.

Some of the parts that are produced by cold forming under production conditions are front suspension shafts, standard transmission output shafts and three-inch-diameter sun gear blanks. Representative parts are shown in the accompanying figure.

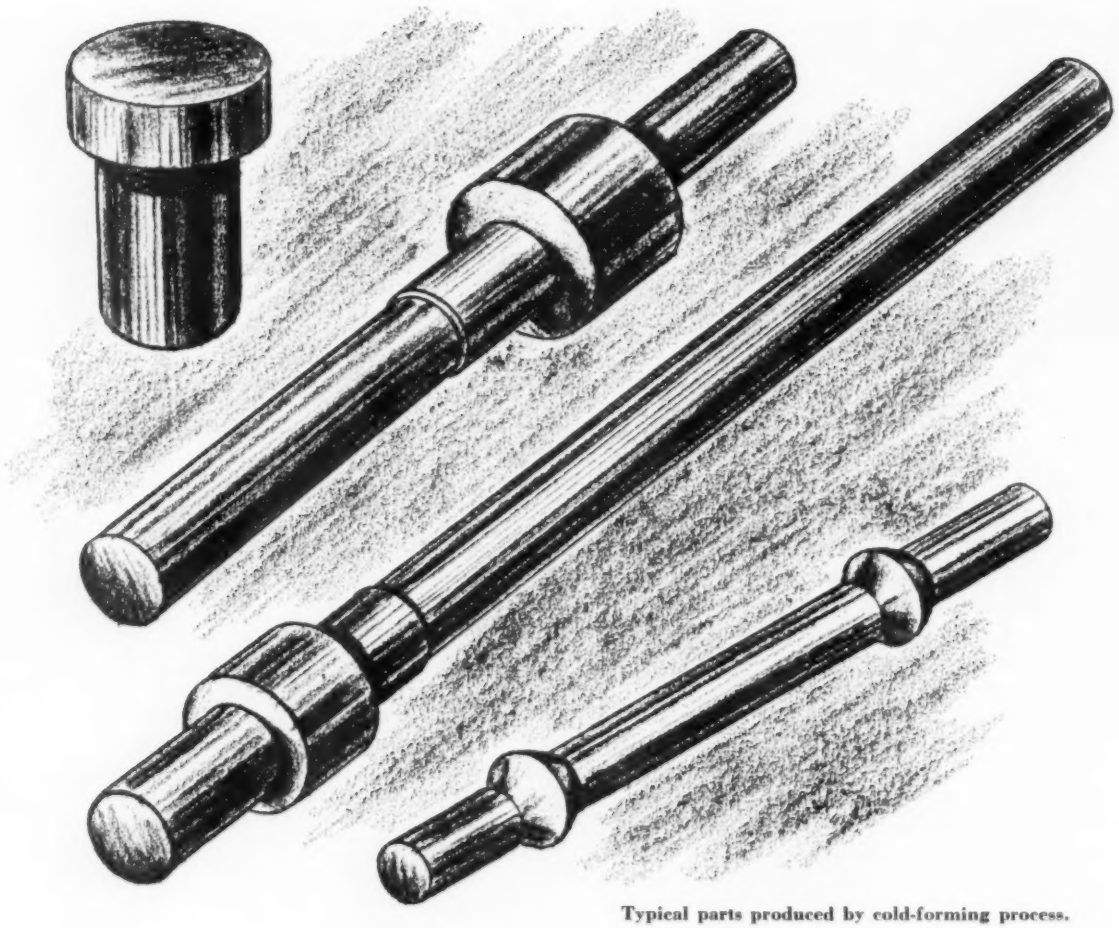
The improvement in die life with cold forming is spectacular. Typically 10,000 parts can be produced on a hot-forging die and 50,000 parts on a cold-forming die. In some cases, 190,000 hits have been obtained from one cold-forming die.

The improved die life is the result of several factors. First, the cold billet is relatively scale-free. Second, hot-working dies tend to "grow" during their production lives; heating causes metallurgical changes. This growth may make reworking necessary even when a die is not yet worn. Cold-forming dies, on the other hand, do not grow and, generally speaking, it is possible to cut blueprint tolerances in half if parts are to be produced by cold forming, since no allowances need be made for die growth.

With cold forming, close control of billet volume is necessary. Excess material cannot be flashed out of the die, as is the case with heated material. Consequently, excess material will cause broken dies.

Cold forming will not replace all, or even most, hot-forming operations. The tendency of the material to strain-harden during forming constitutes a severe limitation to the application of the process from an economic standpoint. Those parts whose configuration makes strain-hardening possible require annealing between successive forming operations and these annealing cycles may make cold forming more expensive than conventional forging.

Tonnage requirements also place a severe limitation on cold-forging applications. As a rule of thumb, three times as much tonnage is required to



Typical parts produced by cold-forming process.

cold form a part as would be required to hot forge the same part.

As is the case with hot-working tools, cold-forming tool materials have been standardized. Steels of the W9 and W10 types are used.

According to Ford manufacturing engineers, the number of applications of cold forming will increase when the possibility of cold forming is taken into account during product design. A part that cannot be economically cold formed in one piece, for instance, might be cold formed in two pieces that are subsequently joined together. Savings through cold forming can make this profitable, even with the added expense of a joining or fastening operation. Study of alternatives pays off.

Automation: There are, at present, few examples of automation in the forging industry. Automation, in this respect, refers to automatic loading and unloading of dies and automatic transfer of billets and forgings between successive forging operations.

One of the reasons for this lack of automation is the difficulty of mechanically handling hot, odd-shaped parts. Parts at a temperature of over 2000 F can cause mechanical-handling equipment to break down rapidly. Also, rough billets or forgings in various stages of production are difficult to orient and position mechanically.

Some cold-forming operations, however, have been successfully automated. An example is the completely automatic operation of a horizontal upsetting machine that forms a front suspension support arm in a series of operations in one die.

Conventionally, an operator holds the end of the part with tongs and positions the part in each successive die section as required. In the automated cold-forming operation, parts are loaded into a magazine. Mechanical tongs pull the parts out of the magazine and position them for each successive forming operation. After the last forming operation, the tongs release the part into a gravity chute leading to a shipping container. The operator of the machine keeps the loading magazine full. With manual operation, production was 200 pieces per hour (actual); with automated operation, production is 1650 pieces per hour.

EPOXY DIES
for explosive forming

By B. J. Bryan

Furane Plastics, Inc.
Los Angeles, Calif.

Explosive forming makes it possible to shape complex sheet-metal parts in one operation, rather than the series of operations often required for conventional forming. Spectacular cost savings have resulted and these savings can be made even greater by using easily fabricated epoxy dies, which stand up well.

EXPLOSIVE FORMING—also called high-energy-rate forming—has advanced in less than two years from an experimental process to a process that is used on a production basis in several plants. To tool engineers in the aircraft industry, it represents the only possible way to produce some intricate shapes and configurations in sheet-metal parts.

The process has been used to form titanium, Inconel, Rene 41, Hastelloy-X, 321 and 17-PH stainless steels, magnesium and aluminum. Shapes such as spheres, cones, bulged tubes, *Fig.* 1, cylinders and corrugated panels can be produced at low cost. Tolerances as low as 0.002 inch can be held under production conditions.

Basically, explosive forming is a method of using the shock wave and gas pressure of explosives to form a metal. By carefully selecting the amount and type of explosive, it is possible to control the gas pressure and rate of material deformation to produce almost any desired end result.

Four primary elements are required: a metal blank; an explosive charge; a die; and a medium (usually water) to transmit the explosive force to the material so that it will form to its final configuration. For hemispherical and cylindrical shapes, sheet metal usually is first butt-welded to form a tube. The explosive is suspended in the tube after the latter has been positioned inside the female die. To fabricate flat parts, a metal blank is placed on top of the die and sheet or shaped-charge

Fig. 1. Operator holds typical bulged part formed with explosives. The forming operation is performed in the tank shown in the background. Part is of 0.063-inch-thick L-605, a cobalt-base alloy.

explosive is set over the metal. In both instances, the assemblies are submerged under water before the explosive is detonated.

The various explosives employed (dynamite, primacord, cyclonite, etc.) develop extremely high power and rapid gas generation. For that reason, charge sizes must be exact and charges must be properly located in the die. Metal is moved into shape at speeds of 200 to 500 fps as compared to 1 to 5 fps for conventional forming. On detonation, water transmits the shock wave uniformly from the explosive to the part. This shock wave causes the metal to deform beyond its elastic limit and thus contact and conform to the die surface. Even materials such as titanium, which is difficult to form mechanically because of its brittleness in the cold state, can be formed explosively without difficulty.

Advantages: No new metal-forming technique could so capture the imagination of engineers in dozens of different industries unless it had demonstrated superiority in many ways. Explosive forming offers the advantages of lower forming cost, no springback, decreased work-hardening, close tolerances and increased metal ductility.

Considerable savings are realized by the elimination of tooling. For example, to produce the 6061 aluminum nose cone for a DC-8 jet plane by assembling welding five separate pieces, *Figs.* 2 and 3, would have cost $131. The same part cost only $15 when explosively formed. It was possible to dispense with a series of drop hammer dies, a number of weld fixtures, an expanding mandrel for shaping, and final surface finishing operations.

Springback (the tendency of metal, particularly high-temperature alloy, to return to its former shape after forming) has always been a problem in conventional forming. When explosively formed, metal contacts the die face and stays there without springback. To overcome work-hardening of metal as it is progressively formed by conventional methods, parts must be annealed between successive forming stages. With explosive forming, work-hardening is not as great a problem as with conventional forming techniques. Consequently, the need for annealing operations is reduced.

Elimination of springback also permits much closer tolerances than were formerly obtainable, in some cases to within 0.002 inch of the die itself. Such tolerances are commonplace even in parts up to two feet in diameter. By comparison, obtaining even 0.015-inch tolerance by conventional forming would be most difficult.

Another important advantage of explosive forming is that it increases metal ductility. Certain metals can actually be stretched beyond the point that would result in breakage in conventional forming. Surface finishes, especially those produced on the epoxy dies, are extremely good and have the added advantage of not requiring subsequent finishing operations to obtain smoothness.

Die Considerations: Although steel and Kirksite are still being used for some explosive forming dies, it can safely be predicted that it will be only a matter of time before epoxy-faced or all-epoxy dies account for 90 percent of all such tooling. And that time will move even closer when various misinterpretations about explosive forming are dispelled.

One common misconception is that the explosive taking place in the die cavity is of such great force and intensity that a massive steel die is needed to contain it. This is not correct. By the time a shock wave having a pressure of 2 million psi at the surface of the explosive charge passes through six inches of the water-forming-medium to the metal, there is only about 30,000-psi pressure on the die face itself. Actual pressure on impact is never as high as the charge itself would lead one to believe. Consequently, the use of plastics dies is feasible. They can withstand explosive impacts. One aircraft company currently plans to change from steel dies to epoxy dies completely.

Advantages of Epoxy Dies: The primary advantage of epoxy dies is lower fabrication cost. Epoxy-faced dies are produced directly from the master and duplicate it exactly, thus eliminating many hours of handwork. In contrast, Kirksite dies are cast, then ground to a blue block to match dimensions with engineering loft information. The

resulting die is three steps away from the master, which increases the margin of error.

Savings in time and labor are illustrated by fabrication of the DC-8 nose cone. The epoxy die for the cone was completed in 16 hours total time.

Twelve days would be required to construct a metal die for the cone, because of the intricate shape and the large number of beads. Grinding the required 100-microinch surface finish would have been difficult. Finishes of this order are mandatory for explosive forming, since a formed part will pick up the slightest imperfections in the die surface.

Another difficulty overcome with epoxy dies is that of granular embedment. When metal is formed over a metal die that is not smooth, friction can build up to a point where the metal being formed will become embedded in the die surface. The resulting pinpoints on the formed part must be ground out. Epoxy resin-faced dies are absolutely smooth and can take repeated impact without deterioration of the surface.

The ease and speed with which design changes can be made is another advantage of epoxy dies. Savings in cost—as compared to the cost of reworking a comparable metal die—are 60 to 70 percent. Savings in elapsed time are anywhere from four days to two weeks.

Life of epoxy explosives forming dies is good. Hundreds of parts can be explosively formed in one die without reworking. A company forming missile skins from the extremely tough $\frac{3}{8}$-inch-thick Hastelloy-X expects to obtain more than 200 pieces from one die.

Over 150 perfect aluminum nose cones have been formed (at last count) without any signs of wear on an epoxy-faced die. The cost of an epoxy-faced die usually is amortized when 200 pieces have been formed.

Die Capabilities: Epoxy dies can be utilized for most types of explosive forming, including dimpling and embossing. Dies for these processes hold up quite well. Epoxy dies are ideal when the parts to be formed are exceptionally intricate, such as spheres and bell-shaped parts. It is possible to fabricate hinged split-half dies in which a sphere or bell is formed in one shot. To construct an epoxy die of this type, two split metal cores are opened up to receive the master pattern. After the die is closed, casting resin is poured around the pattern. Following resin cure, the die is opened to permit removal of the pattern.

Parts formed in such dies require much less finishing than those produced by the usual method, in which two mechanically formed hemispheres are welded together and subsequently finished by grinding down the beads.

The only limit to the size of an epoxy die is the size of the container in which forming takes place. An epoxy-faced die now being constructed by the Rocketdyne Div. of North American Aviation, is 12 feet in diameter and 69 inches high. It has a reinforced epoxy liner and a reinforced cement backup. A mass casting resin fills the cavity between the laminate and backup. This die is one of the largest now under construction but it does not represent the maximum possible size.

Cast-Face Dies: Of the three different types of epoxy dies that can be made—cast-face, laminate-face and solid epoxy—the cast-face type is regard

Fig. 2. Aluminum nose cone, formerly produced as a five-piece welded assembly, left, is now produced as a one-piece part by explosive forming, right.

ed as the least desirable for explosive forming. When a cast epoxy-faced die is used to produce flat metal parts with long vertical sides which have no draft, for example, the plastic seems to compress slightly on impact and the part sometimes fuses with the die face itself. Separation is extremely difficult. Another and more serious problem is that the die has a tendency to deflect just enough to crack the cast face, sometimes right through to the metal core.

Ryan Aeronautical Co., which used cast epoxy-faced dies almost exclusively when it was turning out limited numbers of parts, has now changed over to laminate-faced dies for production use. A major reason was that after twenty nose cones had been explosively formed, the cast epoxy face began to crack. However, from a cost standpoint, a cast epoxy die face would be preferable if the material would stand up to the peculiar conditions of explosive forming.

The pros and cons of cast versus laminated facings are still being hotly contested by plastics tooling specialists. Earle Williams, tooling engineer for Rohr Aircraft Corp., has a theory concerning the adaptability of a resilient epoxy tooling formulation as a casting medium. He says:

"Despite the present difficulties with cast-faced dies for explosive forming, the problem is one that can be overcome with a specially compounded, resilient epoxy resin—one with a certain amount of flexibility, plus the ability to return to a set configuration after impact or compression.

"While epoxy-faced dies with high impact resistance have been in service for many years in drop hammer, stretch form and double action presses, the problems in conventional metal forming are a world apart from those encountered in explosive forming.

"The focal point is shock. Thus far it has been proved that after the preliminary shock wave has completed actual forming, impact of the metal part against the die face creates a secondary shock wave which opens the closed die to an imperceptible degree. The force being expended against the die is the action, while the secondary shock is the reaction, limited in effect by the mass of the die. This is perhaps why some of the original dies for explosive forming were composed of such tremendous mass—to prevent even slight die movement.

"We have since learned that deformation of the part, however, does not continue beyond the surface of the die because of the initial shock wave produced by the water forming media. When transmitted to the metal, this shock wave causes it to deform beyond its elastic limit. Impact of the material against the surface of the die stops material motion, and the force is thus continued to the die, causing an expansion of its surface.

"It is here specifically that the resilient epoxy resin will be of great value. It should provide a sufficient barrier to the material's further movement and result in a part configuration which will be sustained in the part even though the secondary shock wave causes a compression of the die surface.

"Since most of the resilient epoxies are capable only of lower temperature ranges, the cast face would be impractical if the temperature created by detonation was maintained for any duration in the die cavity. But with water as the forming medium, the approximate 900°F temperature generated within the shock wave exposes the die surface to only instantaneous high heat. This would not harm the resin in any way."

Fig. 3. Blank and epoxy-faced die for explosively formed aircraft engine pod nose cone.

Laminated Dies: Cast faces require less time and labor than the construction of laminates. However, until efforts to develop suitable cast materials are successful, laminated die faces will be the most widely used.

Constructing reinforced epoxy resin dies for explosive forming requires no special techniques, *Fig.* 4. Parting agents are first applied to the pattern, which is prepared from loft information. A typical laminating resin is prepared by mixing 100 parts of Epocast 10K resin with 16 parts of 9816 hardener. Actually a high-temperature resin, the 10K is cured with a room temperature curing hardener to eliminate the need for post curing. The combination also results in a boost of 100 F in operating temperatures over the resin-curing agent combination recommended for cast dies. After the resin has fully cured, it will withstand instantaneous exposure to 900 F without ill effect. Pot life of the mixture is 30 to 40 minutes.

Laminating takes place by wet lay-up methods, with a sufficient of layers of glass cloth being applied to produce a one-half-inch thickness. Dry lay-up laminating is not used since it would require vacuum bagging and postcuring. Glass cloth is still the most widely used reinforcing material but quartz and metal cloth are also being given consideration. Excess resin is squeegeed out of the cloth after lay-up is completed. To ensure a definite ratio of 40-50 parts of resin to 100 parts of cloth, technicians in some plants first wipe out the excess resin and then vacuum bag the laminate. With the Epocast 10K—9816 hardener system, this is an unnecessary step.

At the end of 12 hours at room temperature, the laminate has cured sufficiently to permit removing it from the pattern, but ultimate physical properties are not achieved for at least 72 hours. Ambient temperatures during lay-up and curing should be in the neighborhood of 70-75 F at all times, since pot life and cure cycles for the resin formulation are calculated for this range. Laminate thickness is usually determined by the hardness of the metal to be formed and the size of the explosive charge required to form it. Aluminum forming requires a minimum ⅜-inch thickness, while forming titanium requires at least ½-inch thickness.

After the laminate has cured, several things can be done with the shell. A metal or reinforced concrete backup can be made which has clearance from the shell's outer dimension. The shell can be diked up and the balance of the casting filled with an epoxy aggregate backup. Or, alternatively, the shell can be suspended above a metal backup so that a mass casting resin can be poured between laminate and core surface. In each case, part design dictates the method.

Ryan Aeronautical Co., which now has a production line setup for explosive forming, has achieved excellent results with laminate-faced dies backed up with a resilient casting epoxy. Ryan engineers have found that this method minimizes die deflection and shock in the production of parts with vertical walls. On the average, the dies have a compressive strength of 20,000 psi and a tensile strength of 12,000 psi.

To produce the die for the DC-8 nose cone, a plaster splash was first taken from the master model. By wet lay-up technique, five layers of Volan finished 1581 glass cloth were laid up on the splash, which had been gel-coated with an epoxy resin. In order to avoid the possibility of voids in the laminate, the first layer of cloth was pressed well down into the surface of the gel coat while it was still tacky.

Following resin cure, the laminate was suspended several inches away from the surface of the Kirksite backup casting. To completely fill the cavity between the two, an epoxy casting resin was poured in and this material was allowed to cure.

In recent months Rocketdyne has embarked on

Fig. 3. Welded blank for production of steel hemisphere. Concrete pit is filled with water prior to explosive forming. Water transmits shock wave.

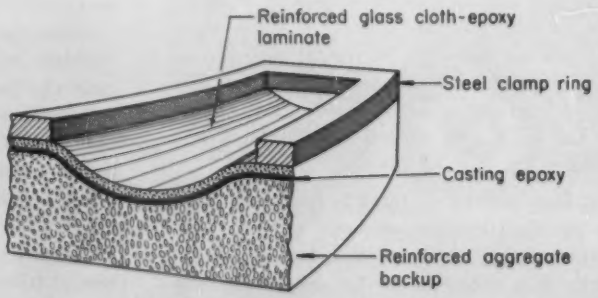


Fig. 4. Basic construction features of a reinforced epoxy resin die used for explosive forming operation.

Fig. 6. Epoxy-faced die, anchored in concrete pit, is used to produce steel hemisphere.

a feasibility program of explosive forming of metal parts since the company is concerned with a forming requirement for which no data is directly applicable. To produce the steel hemisphere illustrated in *Figs.* 5 and 6, the reinforced epoxy die liner was constructed with a surface coat of epoxy resin and hardener with 116 glass cloth (0.044 in.); epoxy laminating resin and hardener with 1588 glass cloth; and the same resin-hardener combination with 150841 glass cloth (0.028 in.).

After the liner was cured, trimmed and drilled, it was positioned in a previously prepared concrete pit. Clearance space between outside surface of liner and inner wall of the pit was filled with a mass casting epoxy tooling resin.

All-Epoxy Dies: All-plastic dies are receiving increasing attention because they reduce manufacturing costs by up to $90 per cubic foot and also cut die weight by at least 75 percent. Substituting epoxy resins for the metal backup eliminates the cost of reclaiming the cast metal plus the loss sustained by degradation of the metal each time it is repotted. However, female dies must be backed up with steel, cast metal or reinforced concrete when extremely high forming strength is required.

Construction of all-epoxy dies requires a laminate facing over the mass body casting since a surface coat would be subject to crazing. Dies are produced by first making a laminate directly from the original pattern, and then casting a filled epoxy resin behind the laminate. A typical mass-casting formulation consists of 20 pounds of resin, five pounds of hardener and 23 pounds of a ground walnut hull filler that imparts high strength and also reduces the cost of the die.

Resin Hardness: According to Ryan engineers, the casting resin between laminate and core surface serves as a backup to absorb forming shock. The method is analagous to the use of resilient epoxy resins in draw dies and other dies where resilient die surfaces are required to permit the formed metal to flow into position.

The impact resistance of a tooling resin is related to its Shore hardness. Most successful mechanical forming has been accomplished with dies of 60-65 Shore hardness on the "D" scale. In explosive forming, the goal is usually 70-75 Shore. It is possible to attain a 90 hardness reading, but there is a chance that the resin would be too brittle for explosive forming.

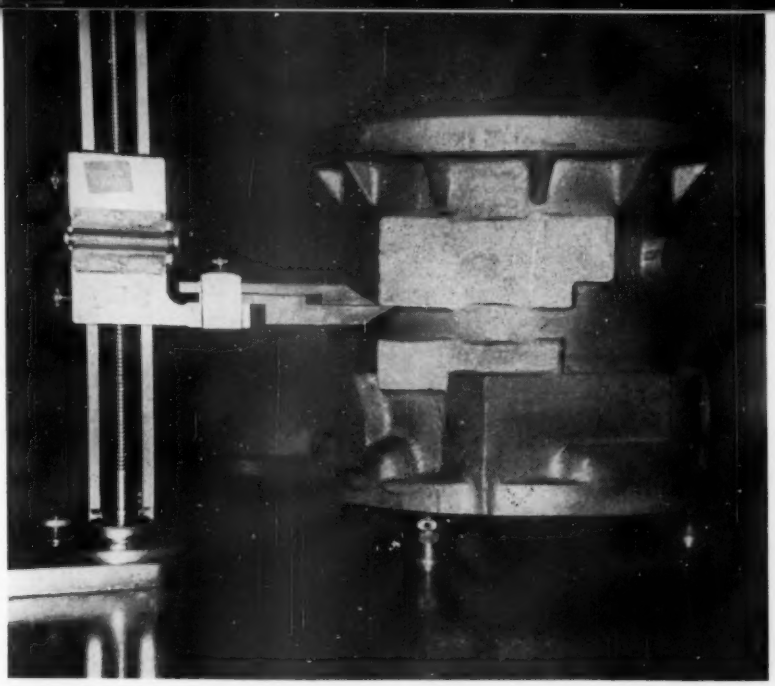
With the specific formulation used by Ryan, Shore hardness can be controlled by the amount of hardener employed in the resin mixture. For example, in a die requiring a 50 Shore hardness, about 40 parts hardner would be used. For a harder surface, up to 70 Shore, the proportion would be dropped to about 20 parts hardener.

Die Changes: Under normal conditions, a laminate-faced or all-epoxy die will not be impaired by explosive forming since the explosive charge does not directly contact the die surface. Should there be an overcharge of explosive, it is conceivable that the stress upon the epoxy face would be beyond its limitations, cracking or actually fracturing it.

Such damage can often be repaired. A localized die fracture can be repaired with minimum effort and little time loss. A fracture of the laminate completely through to metal backup is another matter, and repair would be most difficult. In such cases, it would be simpler to build a new die surface.

Salvaging a cracked nose cone die presented no problem. The resin was first burned off. A new die face was prepared by building up a laminate to the master pattern, positioning the cured shell over the original Kirksite core and filling the space between the two with mass casting resin.

Die redesign is easily handled, requiring only that the die be dropped into the reworked master for laminating to the new tool configuration. This ease of fabrication and ease of reworking is leading to many additional applications of plastic tooling to explosive forming.



Scribing blades being used to scribe line on casting. Lower blade is used for underside of projecting surface.

SCRIBING BLADES facilitate checking

By John R. Attig*

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EVERYONE who has done sample casting or forging layout by means of a vernier height gage has at some time given the familiar exclamation, " . . . forgot to allow for the blade!" This human error is usually caught and rectified with a nominal loss of time and patience. However, when the pressure is on the layout man for fast dimensional approval or rejection of a first sample casting or forging with a complicated configuration, this error seems to recur more frequently. Sometimes a layout man, in order to make up time and to avoid possible future error in the layout, scribes all lines with the blade in one position. A fuzzy inaccurate line on the under side of a spherical boss, pipe or flange is the result.

The chance of error due to forgetting to account for blade reversal is eliminated with blades of the patented configuration shown in the accompanying drawings. No blade reversal is necessary because of the common datum line from scriber points, through the blades, to the datum bar on the gage.

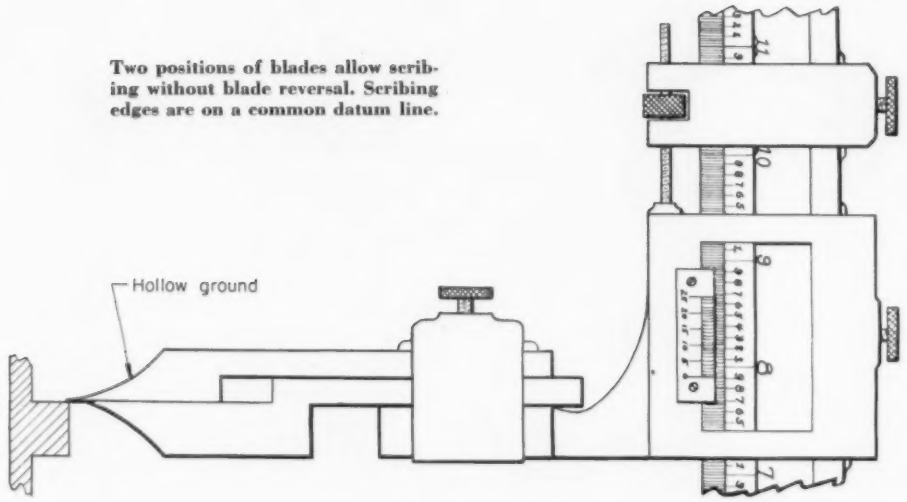
Each of the parts has a recessed shank and is placed so that its scribing edge is in the same plane as that of the other. Thus, shifting the blades in relation to each other puts either the upper or lower blade in scribing position. Another feature of the composite blades is that they are interchangeable with conventional single scribing blades within a given height gage size range.

The blades are manufactured to tolerances on the datum line dimensions of ± 0.0005 inch, and have a natural lapping action, so that the blade improves with use. The cutting edges are hollow ground for easier honing as the cutting corners dull with use.

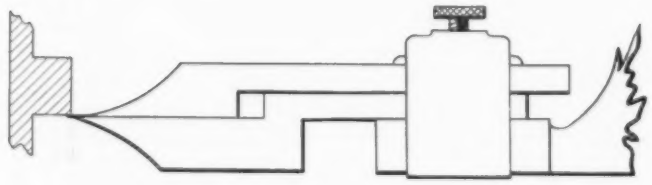
The blades are primarily designed for use in casting or forging layout work where proof of dimensional accuracy from pattern or die shrinkage is required. However, they have also been used in conjunction with indicator work, using the blades

*Senior member ASTE Fairfield County chapter.

Two positions of blades allow scribing without blade reversal. Scribing edges are on a common datum line.



Upper Blade in Scribing Position



Lower Blade in Scribing Position

in either position to determine hole size or location.

For tool tryout purposes, two original sets of blades were manufactured, using ground flat stock as basic material. In laying out a first piece sample casting, the estimated time saved was at least 20 percent. The absence of time and motion in having to allow for blade reversal and additional figuring, not only cut the layout time, but contributed to helping the operator concentrate on actual casting discrepancies. Cleanness and accuracy of scribed lines with the blades in both positions was notable. Interchangeability of the blades is a feature attractive from a shop budget standpoint.

Once that the practicability of the blades was established, two methods of fabrication were investigated. These were precision casting and forging. Both methods proved to be comparable in cost since the higher cost of forging dies was offset by savings resulting from fewer machining operations.

"Aw I just can't bring myself to squawk about his work somehow."

ROLLING AND PEENING
produces smooth finishes

By Donald Walker *
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Roll-peening with bearingizing tools improves metallurgical properties while producing smooth finishes in holes and on flat concentric surfaces. The author describes the process and typical applications and gives reference data to aid in hole surface preparation and sizing.

BEARINGIZING is a process for obtaining high surface finish and increasing hardness on metal surfaces. It is accomplished with tools specifically designed for the purpose which consist of hardened steel rollers arranged to roll over a cammed surface within the tool. In the case of a tool for hole finishing, the rollers are contained in a cage around the periphery of a cylindrical cam.

Tools are revolved at high speed and, as they are inserted in the hole, pressure on the hole side causes the rollers and cage to revolve around the cammed tool shank. Thus in addition to a rolling action, the rollers, pushed outward by the cams, impart a series of rapid radial blows to the work surface. The process might be likened to rotary swaging except that, in the case of bearingizing, the race rolls are used to peen the work instead of hammers and dies.

Bearingizing tools can produce surface finishes and size control comparable to those obtained with grinding and honing. Spindles to drive the tools need only have sufficient speed to provide desired tool action and accuracy necessary for proper tool location. Successful applications have been made on a variety of machine tools including upright drill presses, radial drill presses, turret lathes, speed lathes and milling machines.

Fig. 1. Bearingizing a flat surface on a Chrysler torque converter front cover. Time per piece is about 8 seconds including load and unload.

Applications: Bearingizing can be applied to holes, concentric flat surfaces, *Figs.* 1 and 2, round shafts, stems and hubs and other contours that are adaptable to rotary motion. The process is used to finish and size wrist pin holes in pistons, *Fig.* 3, sintered bronze bearings, ball bearing bores for electric motor end bells and holes in various other products. Angular and flat surfaces finished by bearingizing

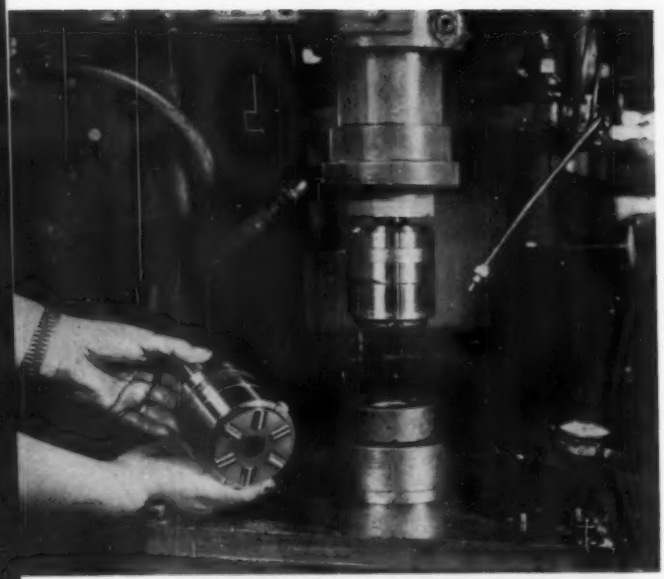


Fig. 2. Tools used for processing covers shown in *Fig.* 1. Tool life is 10 days of three shifts or a total of about 8500 pieces per set of rolls.

include: oil, air and gas sealing surfaces on valve seats, water pump sealing faces, high pressure hydraulic valves and pumps. OD tools have been applied to obtain ball-bearing fits on motor and generator armatures, steering knuckles, automatic transmission parts, and hydraulic pistons.

Surface Preparation: Inasmuch as bearingizing is a finishing process, parts must be pre-sized and, to a degree, pre-finished. Bearingizing can be used to improve surface finish and structural characteristics of a honed, ground, bored or reamed hole. Single-point boring is the most desirable means of preparing the surface since it leaves a consistent peak and valley surface that flows readily. Reamers can be used with excellent results, provided the 45 deg front cutting angle is changed to 20 deg front cutting, to more nearly approach an end cutting condition and produce the peak and valley configuration that is desirable. Feed rates on single point boring are generally from 0.002 to 0.010; ipr according to the material and work piece. Reamer feeds are generally higher.

Hole Sizing: Although bearingizing tools have been in use a number of years, their application requires a certain amount of job engineering. The reason for this is, that unlike conventional grinding or cutting processes which actually remove metal, the process flows the metal. Metal will retain some of its original elasticity unless it fractures or flakes out on the surface. As the bearingizing tool is released from the part, those molecules which have been in compression will expand. Some variation of this expansion must be expected in a production run, owing to variations in commercial material. Because of this spring-back characteristic, a certain amount of trial is necessary to determine the prepared hole size to arrive at the correct bearingized hole size.

Data in *Figs.* 4 through 9 are helpful in determining the hole size and tolerance to use when preparing a hole for bearingizing. These charts represent the cumulative average from a series of trials and, therefore, represent a starting point for the shop trials. The final determination of the prepared hole size and tolerance should be obtained from shop trials on the specific work piece involved.

To select a starting point for determining the exact prepared hole size on a given application requires only simple interpretation of these charts. Assume for example that a typical case would be a stainless steel part with finished hole limits of 0.6250 and 0.6255 inch and a 10 microinch finish requirement. Looking at *Fig.* 4 it will be noted that the required 10 microinch finish can be obtained with a prepared hole to tool diameter difference ranging from 0.0017 to 0.0023 inch. In this range of diameter differences, the hole diameter will be increased from 0.0006 to 0.0008 inch. To determine high limit of the prepared hole, merely deduct the low value of the diameter increase from the high limit of the finished hole. To determine the low limit of the prepared hole, deduct the high value of the diameter increase from the low limit of the finished hole using values from the charts.

Out of Round Holes: As long as the eccentricity of out-of-round hole does not exceed the total size change that takes place, the eccentricity will be

Fig. 3. Double spindle bearingizing setup in automotive plant to process aluminum automobile piston wrist pin holes. Parts are pushed onto tools manually.

considerably reduced—again dependent upon the spring-back characteristic. This is due to the impact nature of the tool and, because an even number of rolls is employed, they are diametrically opposed and will set the metal rather than stretch it.

Holes that are not longer than the roll length will be straightened in the same manner but, on holes considerably longer than the roll length, the tool will follow the hole.

Tolerances: Final tolerance on holes will vary with the input (prepared) tolerance and the metal springback characteristic. On material such as sintered bronze, the spring-back is very slight and therefore input tolerances or plus or minus 0.0020 inch could result in a final tolerance of plus or minus 0.00025 inch. When accurate fixturing is used, closer tolerances are obtainable. On material such as stainless steel, the metal springback is quite high and may necessitate having the prepared hole the same tolerance as the finished hole.

Finish Characteristics: Most materials after bearingizing have surface finishes of 10 microinches or less when proper surface preparation has been made. When checking for surface finishes in highly porous metals such as cast iron or sintered materials, a higher average surface finish reading is usually obtained than the true finish because the profilometer reflects porosity inherent in the material. The cast iron samples used to prepare *Fig.* 8 indicated a 10 to 15 microinch reading. When converting proficorder chart data to microinches and ignoring the porosity factor, a surface finish of 6 to 8 microinches was indicated. Likewise, the sintered bronze readings were 20 to 40 microinches, which when converted, indicated a 8 to 10 microinch reading more nearly representing actual conditions.

Hole Location: The bearingizing process establishes hole diameter and surface finish only and, in general, will not change the location of a prepared

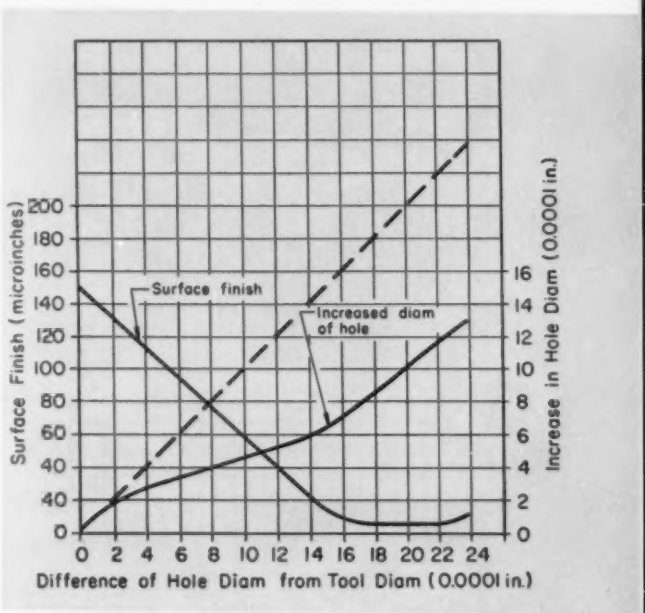


Fig. 5. Chart for determining prepared hole size for type 2017-T4 Aluminum from required finish.

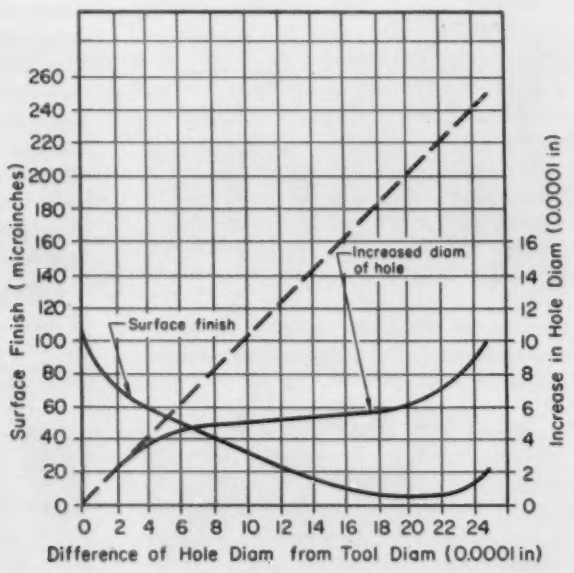


Fig. 4. Chart for determining prepared hole size for type 416 stainless steel.

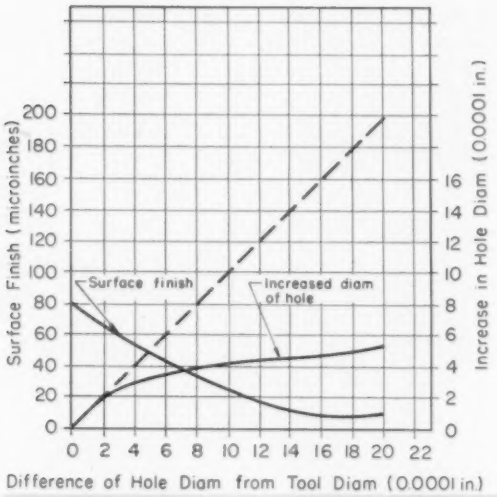


Fig. 6. Chart for determining prepared hole size for brass bar stock from required finish.

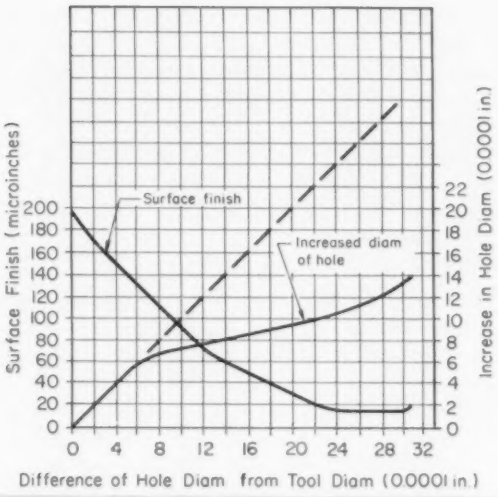


Fig. 8. Chart for determining prepared hole size for cast iron from required finish.

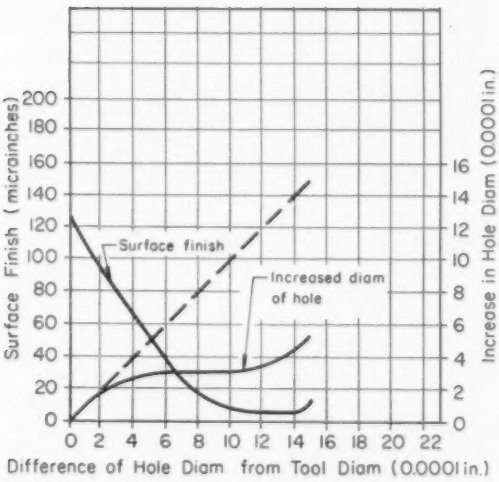


Fig. 7. Chart for determining prepared hole size for type B-1112 steel.

hole. The location of the hole, therefore, should be established accurately in the preparatory single point boring or reaming operation.

Work and Spindle Alignment: The surface to be finished should, of course, be square and aligned with the tool. On relatively small pieces this is most easily accomplished by holding the part manually and allowing the tool to align the work piece to itself. When this is not feasible, the fixture must allow for radial float or the spindle and the part must be in accurate alignment. Alignment may also be achieved by use of a floating holder. Holders should have only radial float and no axial float.

Feeds and Speeds: Tools for holes should operate at 400 fpm at the hole diameter or faster. Lower speeds may give good results, but will reduce tool life considerably. During low-speed operation the roll is in contact with the cam for a longer period creating undue stress and excessive wear. External feed-on or collapsing tools need only operate at 300 fpm, since the cam radius is larger.

Feed rates should be rapid, as slower feeds will cause unnecessary wear and will increase the tendency of the material to flake. Recommended feed rates are from 150 to 250 ipm for tools under 1 inch in diameter and slightly slower feed rates for larger diameter tools.

Taper, flat surface, contour, collapsing and expanding tools should not contact the work piece for more than two seconds. End pressures required on these types of tools will vary considerably with the type of material and the nature of the surface.

Lubrication: Coolant is not necessary, but tools should be cleaned periodically by applying a few drops of light-bodied oil (about 100 SUS - similar to light spindle oil) with a squirt can or brush. The roll cage should be stopped to allow oil to enter the roll pocket, thus, metal dust particles are flushed out by centrifugal force when the roll cage is released.

Thin Wall Structure: When considering the use of bearingizing on parts having extremely thin walls, or thin walls of varying thickness, the hole must be bored to within 0.0005 inch or less of the

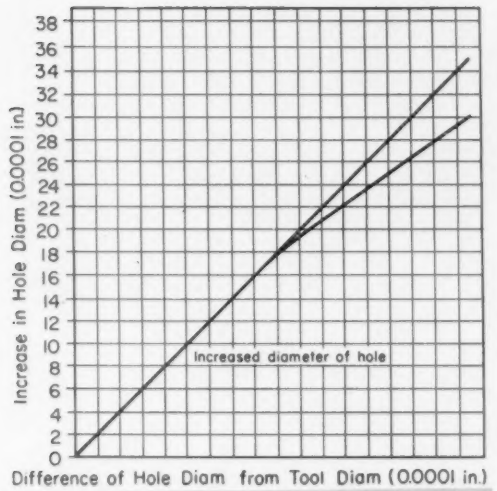


Fig. 9. Chart for determining prepared hole size for sintered bronze.

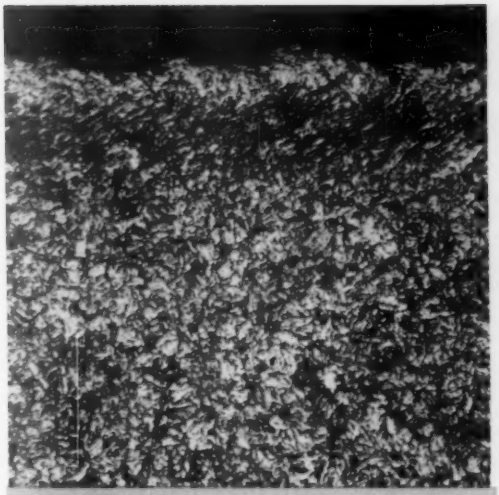


Fig 10. Photomicrograph of bearingized stainless steel (200X).

finished size, with a relatively smooth finish. These applications can also be improved by utilizing fast-rise cams. These are merely deep cut cams with sharp corners, so that the roll will rise and fall very rapidly. This action lessens the tendency for the wall to expand, because the force of the roll against the wall is a sharp, instantaneous impact which lessens the depth of penetration. The need for fast-rise cams can only be determined by review of the physical characteristics of the part and material.

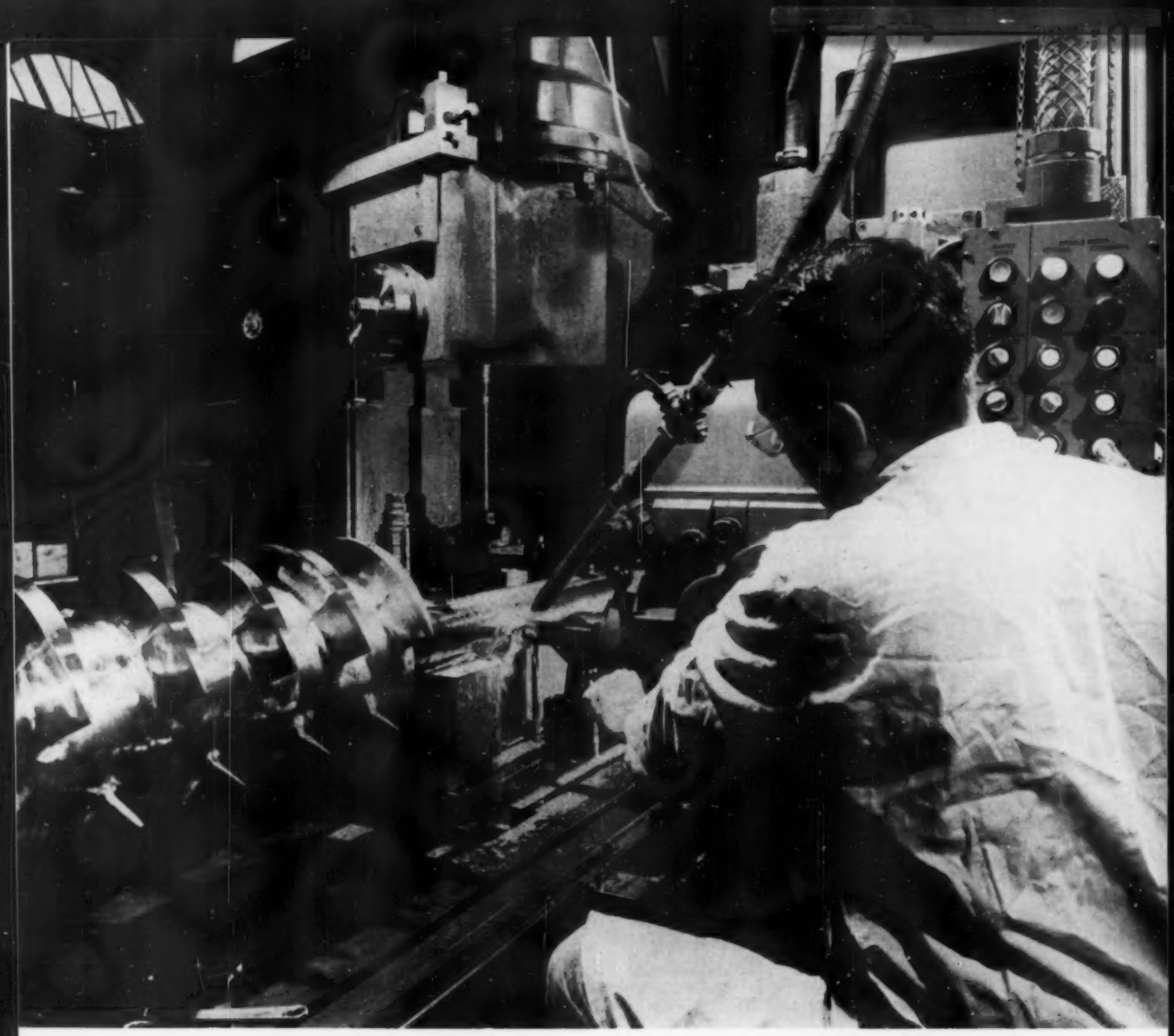
Tool Wear: Bearingizing tool life varies with the hardness and abrasiveness of the material, length of work, speed, lubrication, feed rate and cleanliness. Quantities of from 5000 to 50,000 holes with a 0.0002-inch tolerance for size, roundness and parallelism to the centerline are attainable. A manufacturer of automobile aluminum pistons is currently processing 25,000 wrist pin holes to a 0.0002-inch tolerance with one set of rolls at 10 pieces per minute. When the arbor becomes worn below the required tolerance, oversize rolls can be installed to compensate for wear. Feed-through type tools are generally constructed with three tandem roll positions for long arbor wear life. When the forward position cams become too worn for effective peening action, the roll cage can be shifted back, exchanging position with the spacer to present a new cam surface. Rolls previously used on the forward position can be used again a number of times to provide the correct tool size needed to produce acceptable parts.

Hardness Increase: Inasmuch as the metal surface is compressed during bearingizing, a certain amount of hardness increase takes place. The exact amount is mainly dependent on the material processed. *Fig.* 10 shows a photomicrograph of type 416 stainless steel which has been bearingized. Two distinct directions of grain orientation can be discerned. One is caused by the rolling action present and the other by the peening action which takes place. An increase in Brinell hardness of from 210 to 273 was noted for this particular sample.

Hardness Increase after Bearingizing

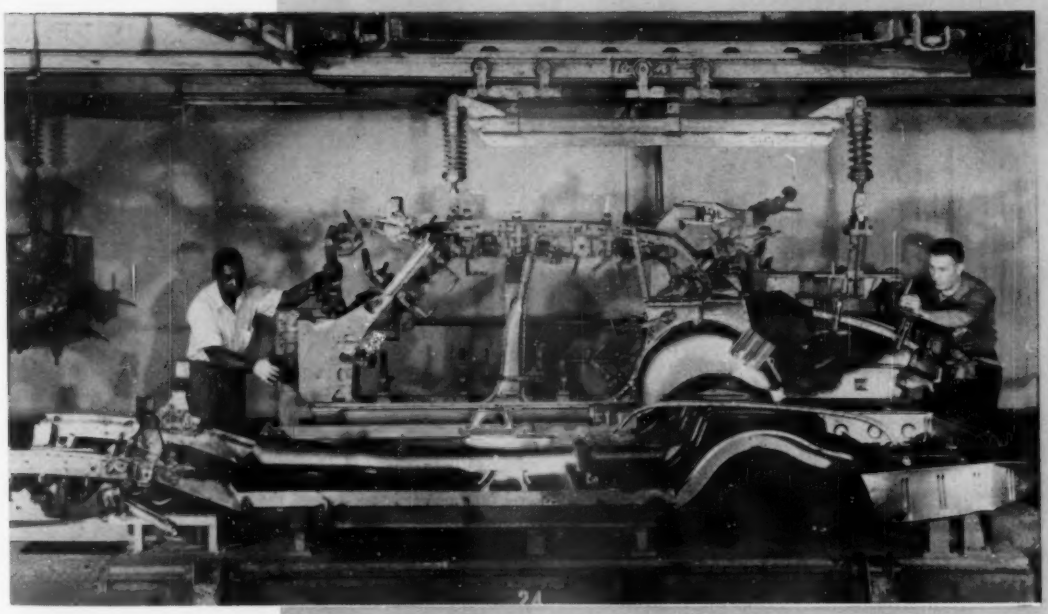
Sample	Hardness (Brinell) Core	Surface
Stainless steel (Type 416)	210	273
Aluminum (Type 2017-T4)	102	122
Brass	116	155
Steel (Type B-1112)	195	240
Cast iron	185	260

The accompanying table contains hardness reading data that was obtained during development of the curves in *Figs.* 4 through 9. These values are typical of hardness increases for the particular alloys cited. In the case of sintered bronze, a superficial hardness tester revealed hardness increase of about 10 to 35 points on a R-15-T scale. No appreciable work hardening took place; however, an increase in density was noted to about 0.005 inch below the surface. Observation of a photomicrograph of a sample used for development of *Fig.* 9, indicated that the oiling properties of the sintered bronze would not be destroyed due to surface closures caused by metal smearing such as might be present after a metal-cutting process.

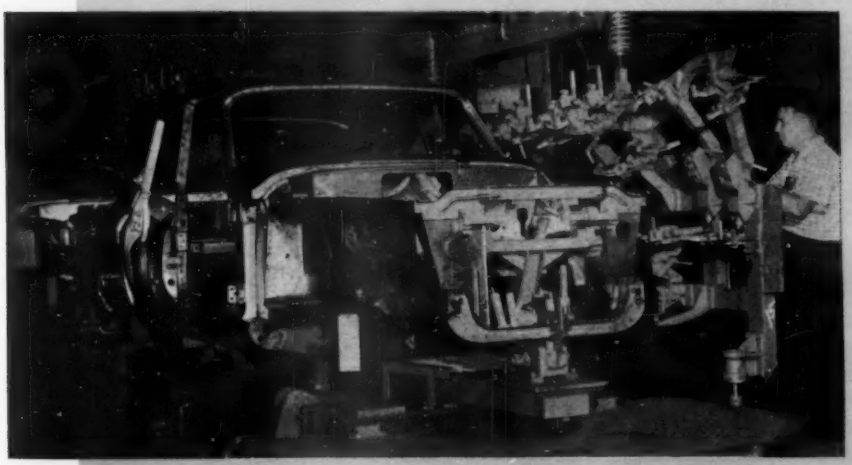


OPERATOR CUTS A KEYWAY in a 16-inch diam screw with the horizontal head of a special 40-foot Cincinnati spiral milling machine. The machine was designed specifically to mill the helix on the long mixing screws manufactured at the Chemical Machinery Div. of Baker Perkins Inc. When milling the helix, fixture rotation controls table movement to produce desired lead. Screw sizes range from 4 to 24 inches in diameter.

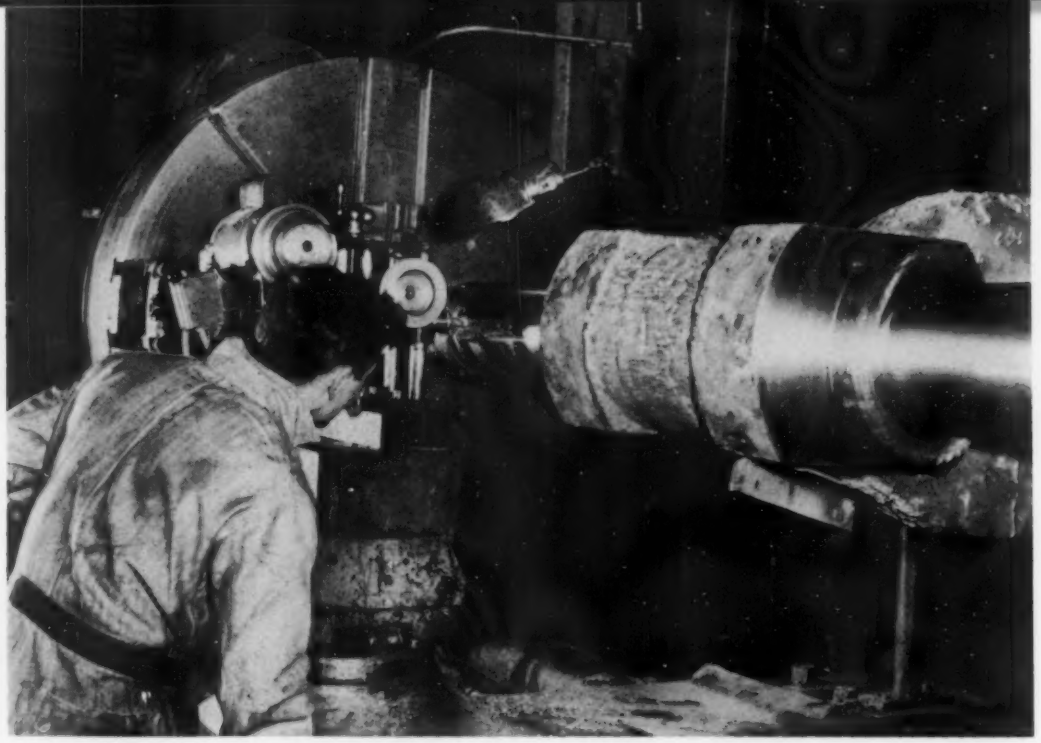
TOOLS at work



GATE-LINE ASSEMBLY METHOD is used by Chrysler Corp. in assembling the Valiant. Front and rear floor pans are assembled on the gate-line base which travel on a continuous track. Body side parts are assembled in right and left-hand gates that are suspended from overhead monorail conveyors. The gates are brought to the base from the sides as shown and locked into place on the base. Manual spot welding joins the parts together. This method is more efficient than stationary body bucks.



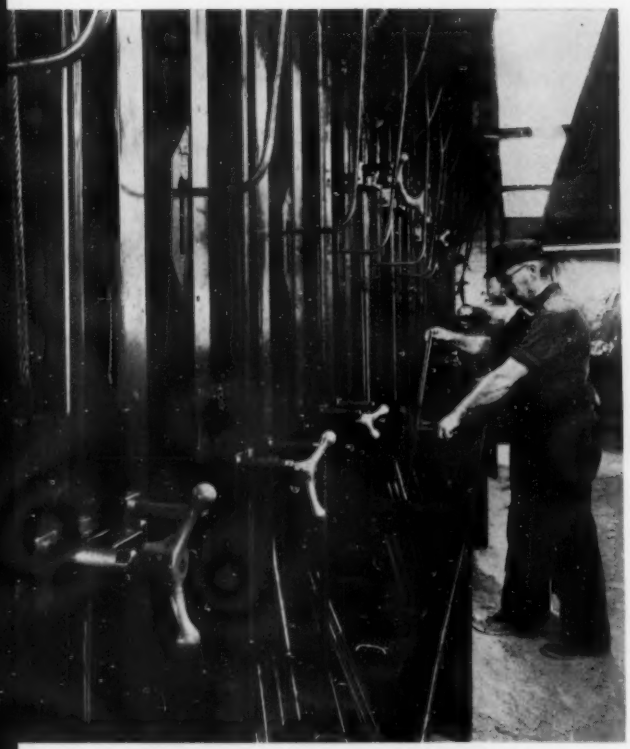
AS COMPLETED VALIANT BODY leaves the assembly line, gates are removed and returned to starting point. Added to the body before gates are removed are dash cowl, top assembly, windshield header, rear window header and other parts and assemblies to complete the body.



KEYWAY IS MACHINED in repaired industrial crankshaft at Industrial Welding & Brazing, Inc., Lansing, Mich. After repair welding, crankshafts are mounted on a lathe and the main bearings machined. Keyways and flat surfaces are then cut with a Dumore Versa-Mil mounted on the tool post before removing workpiece. To speed setup, distance from ways to centers is stamped on lathes.

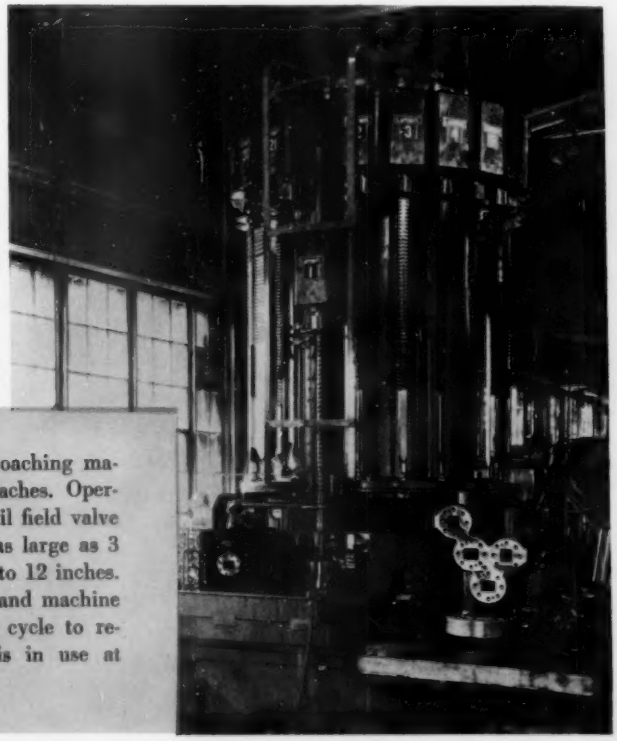
PRESSURIZED aluminum container for transport of missiles has double sheath separated by inflated air cushions. Inside portion has a fiberglass inner liner incorporating electrical heating elements to hold uniform temperature during transit or storage in addition to a two-inch plastic-foam insulating layer. Containers are fabricated at Lockheed, Burbank to accommodate the Polaris missile.

TOOLS at work

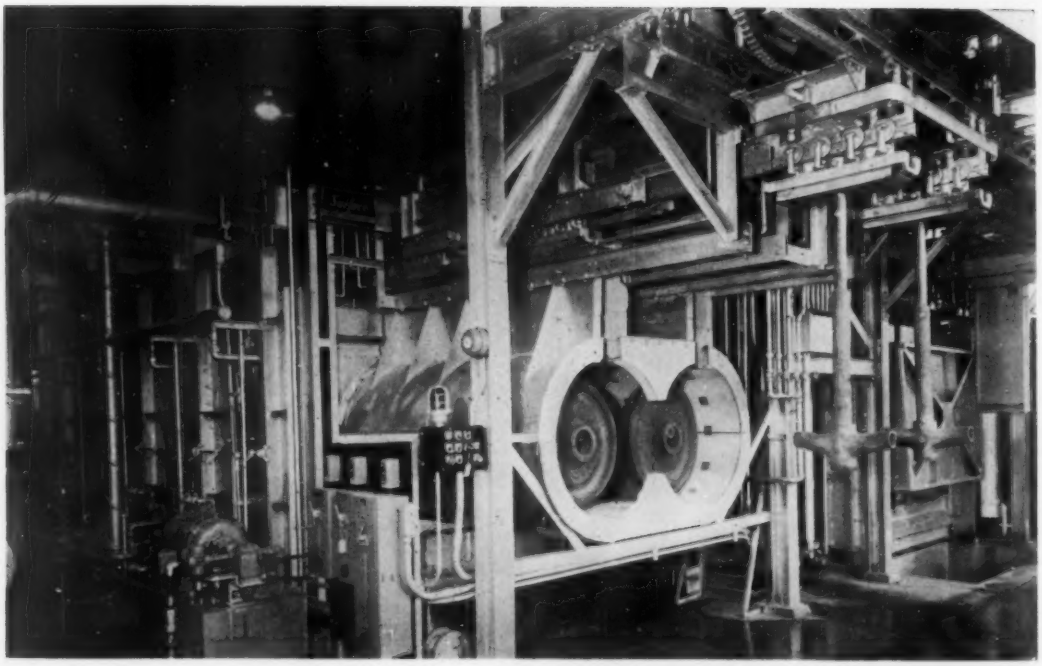


BARREL BORING MACHINE operator inserts a shotgun barrel into clamp prior to boring. The machine at Ithaca Gun Co., has 12 spindles on each side and processes 80 barrels per hour. Bore sizes range from 0.410 to 10 gage. Gulfcut 11-A, a mineral-lard cutting oil is used.

CAST-IRON HOUSING is machined at 550 fpm on a vertical turret lathe at American Coleman Co., Littleton, Colo. Increase in cutting speed from 289 fpm reduced machining costs from $9.72 to $5.57 per piece. Parts are faced on a vertical turret lathe with Kennametal Grade K6 Kendex inserts. Depth of cut is 0.125 inch rough and 0.050 inch finish.

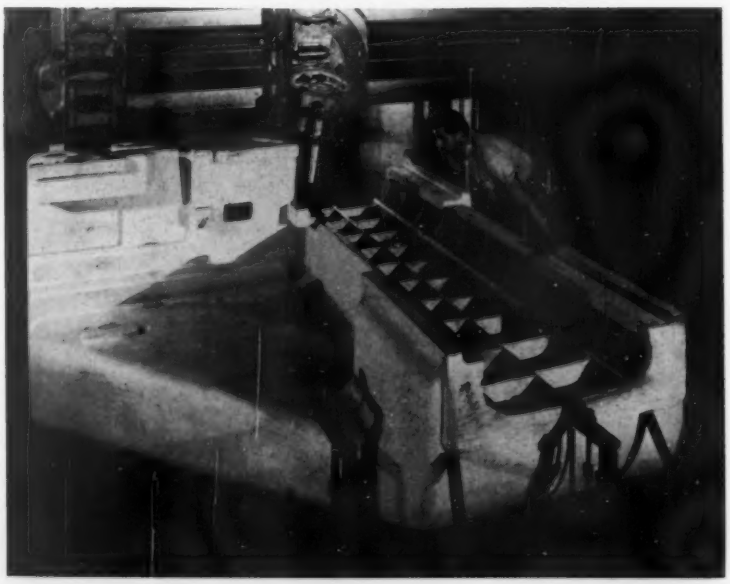


TURRET ADAPTED to a vertical pull-down broaching machine has 21 stations to store 80-inch broaches. Operations are performed on parts such as the oil field valve in the foreground. Broached openings are as large as 3 by 7¾ inches. Length of cut varies from 7 to 12 inches. Operator sets selector switch for each hole and machine automatically proceeds through the cutting cycle to required size. Broach, built by Lapointe, is in use at Cameron Iron Works, Houston, Texas.



CAST STEEL FREIGHT CAR WHEELS are given both a solution heat treatment and a spheroidizing treatment with two overhead conveyor continuous furnaces. The furnaces, built by Surface Combustion Corp., can heat 6250 lb of car wheels and 425 lb of fixtures per hour from 1000 F to 1750 F.

TOOLS at work



CAGE MAKER planes a surface of an eight-ton casting at the Sheffield Corp. The casting will be used as the base of an inspection machine capable of measuring a variety of different size parts. The casting is 112 inches high, 102 inches long and 55 inches wide.

Machining Cast Iron
with ceramic tools

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Center for Metalworking
Metal Research Institute T.N.O.
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Research carried out in the Netherlands confirms the fact ceramic cutting tools for machining cast iron have considerable advantages over carbide tools.

ONE OF THE CHIEF advantages of ceramic cutting tools is that floor-to-floor machining time can be reduced because of higher cutting speeds attainable. Increased rates of metal removal reflect also more efficient utilization of available machine-tool horsepower. Using volumetric metal removal values as a basis, investigators in the Netherlands at the Center for Metalworking of the Metal Research Institute T.N.O. have conducted studies to compare the performance of ceramic tools and carbide tools when machining cast iron. Cast iron was selected for the tests because it appeared to be the most promising in connection with machine tools most widely used in the Netherlands.

The higher metal removal rates possible and more efficient machine utilization when using ceramic tools are illustrated in *Fig.* 1. Most of the data used for constructing this diagram were taken from the experiments, the remainder being drawn from the literature[1,2].

The diagram, *Fig.* 1, shows two cutting-speed lines which represent the relationships between chip cross section and cutting speed for carbide cutting tools and ceramic cutting tools. Tool life in both cases is 60 minutes. The criterion for tool life was either a mean front face wear land of 0.020 inch, or a front face wear land of 0.039 inch at the point where the cutting tool contacts the machined surface of the workpiece. The former value generally was the criterion for carbide cutting tools; the latter value the criterion for ceramic cutting tools. The cutting-speed line for ceramic material has its minimum and maximum at chip cross sections of 0.0006 sq in. and 0.0155 sq in., respectively. The lower limit was determined by the applicability of the available ceramic material and the geometry used; the upper limit was determined by the restricted dimensions of the tool tips and toolholders in general use.

The diagram also shows lathe cutting-speed lines for gross powers of 10 hp and 30 hp. In this example the efficiency of the lathe is assumed to be 70 percent. These lines, therefore, show the relationship between chip cross section and cutting speed for a lathe that is used to full capacity. It can be seen from these lines that at chip cross sections of less than 0.0062 sq in. in the case of a 10-hp lathe and at chip cross sections of less than 0.002 sq in. in the case of a 30-hp lathe it is the carbide cutting tool and not the lathe which determines the maximum cutting speed.

The cutting speed of a 10-hp lathe at a chip cross section of 0.0015 sq in. is about ⅓ of the maximum permissible speed of the lathe. When ceramic cutting tools are used, however, the maximum lathe speed can be used. Hence, when ceramic tools are used, machining can be done about three times as fast while cutting the same chip.

This advantage decreases slightly with increasing chip cross section because tool life becomes relatively shorter. Moreover, there is an increased risk of fracture of the ceramic tool tip.

Workpiece Material: Two lots of pearlitic cast iron were used in the investigation. The first series of tests, which were carried out for

[1,2]References are listed at the end of the article.

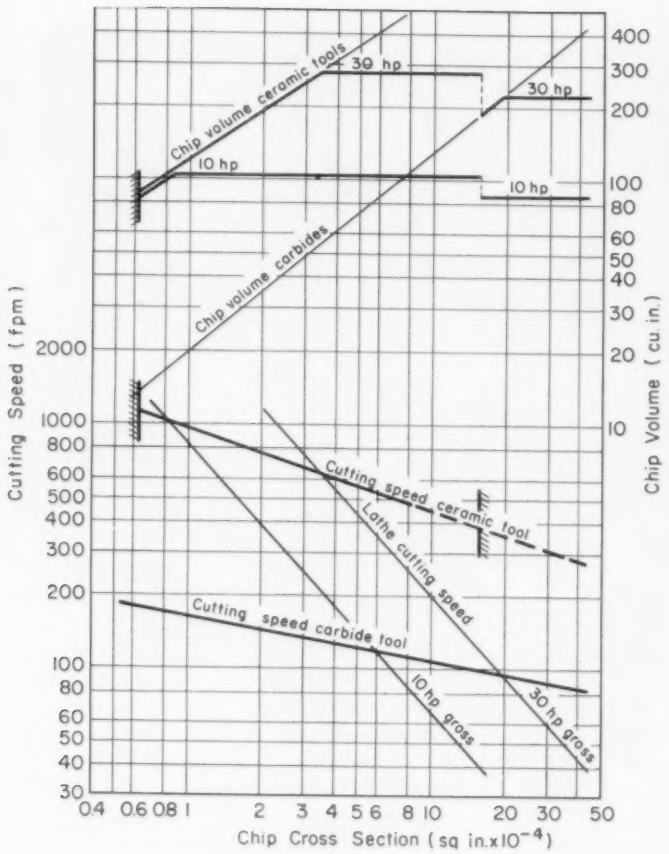

Fig. 1. Comparison of cutting speeds of ceramic and carbide tools at constant tool life of 60 minutes. Ceramic tools allow higher cutting speeds thereby utilizing available horsepower more effectively.

orientation purposes, was done on a lot having a tensile strength of 34,100-37,000 psi at an average hardness of 195 Brinell (range 177-205). The second series of tests, concluding the investigation, were carried out on a lot having the same tensile strength and an average hardness of 235 Brinell (range 230-240).

The material was in the shape of bars having a length of 47 inches and a diameter of 11¾ inches. A total amount of cast iron of about 15 tons was used, of which about 11 tons were removed as chips. All the cast iron used was of a regular and rather coarse structure. The workpieces were carefully chucked between a four jaw chuck and a live center. In order to prevent the occurrence of strong vibrations, the workpieces were partially machined beforehand. The part which had been machined was then chucked, and the scalping operation completed in one pass.

Lathe: All tests were carried out on a Lodge and Shipley lathe manufactured in 1946. This lathe has a swing of 12 inches over the cross slide and a length, measured between the centers, of 55 inches. It is powered, via a Boehringer-Sturm variator, by a 40-hp motor. This variator enables the operator to apply stepless speed changing over a wide range. Through power losses in the variator and the lathe itself the maximum power available at the tool tip was only 18 hp. The lathe used is in reasonable good repair but not free from vibrations. It proved to be possible to avoid serious vibrations through a careful choice of cutting conditions. No relationship between the length of tool life and vibration could be established with any certainty during the tests.

Cutting Tools: Before the tests were started, the tools to be used were graded. It appeared that there were considerable differences in quality among the ceramic cutting tools available. Most of the tests described were carried out with one particular tool material. This material was selected because it performed best of available tool materials when machining pearlitic cast iron.

Measurements: In *Fig.* 2 the symbols are shown which denote wear measurements together with their relationships to the tool. The measurements on the cutting edge of the tool were obtained with a Hensoldt measuring microscope in an adjustable frame *Fig.* 3. This equipment enabled

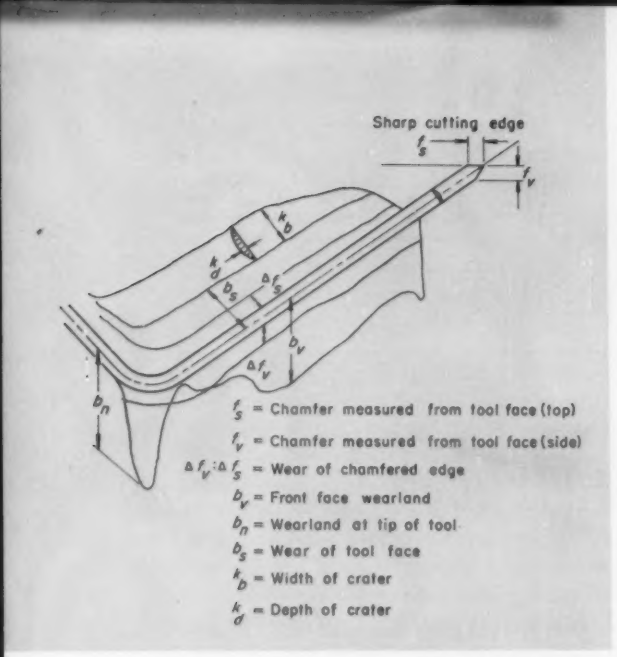

Fig. 2. Measurements taken to determine tool wear.

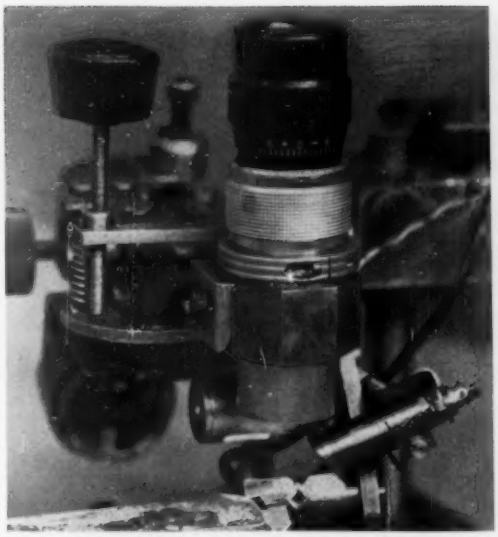

Fig. 3. Microscope used for tests mounted in an adjustable frame was used to check tool wear.

measurement of the wear of the different surfaces without requiring position change of the tool. With the aid of fixtures the tool was carefully returned to its original position in relation to the work after completion of each measuring operation.

Results of the Investigation: In the course of the preparatory tests it appeared that only low feeds in the order 0.017 ipr were feasible. It was soon evident, however, that much larger feeds were possible when tool cutting edges were chamfered. Occasionally good results were obtained by using a feed of 0.043 ipr. Chamfering of the cutting edge also reduced the percentage of fractures.

An attempt was made to determine, at which angle of chamfering the percentage of fractures was lowest. It appeared that a chamfered edge which makes an angle of 30±5 deg with the top face gives the best results, *Fig.* 4. The value of f_s, however, should not be more than one to two-thirds of the feed, since higher values increase the risk of fracture.

In order to obtain comparisons of ceramic and carbide cutting tools, tests were carried out with a toolholder in which carbide as well as ceramic tool tips could be clamped. Wear was then measured at a constant volume of metal removed of 183 cu in. or 15.5 cu in. with varying cutting conditions. A crater formed on all carbide cutting tools which was so critical that it enabled prediction of a maximum tool life of about 15 minutes. In the case of the ceramic tool, wear occurred mainly on the front face and was not critical in any instance. It is, therefore, justified to expect that a much longer tool life can be obtained by using the ceramic tool material. Metal removal capacity is proportionately larger.

For ceramic material to be interesting industrially speaking, it has to be able to stand up to a wide range of cutting speeds and feeds without showing a marked decrease in tool life or ease of handling. Therefore, a series of tests were carried out in which the cutting speed was varied between 460 and 622 fpm and the feed was varied between 0.0118 and 0.028 ipr. The depth of cut was kept constant at 0.118 inch.

In all these tests the front face wear land began by increasing rapidly and then remained practically constant at a low value. In *Fig.* 5, the front face wear land is shown in correlation with the feed for cutting speeds of from 460 to 620 fpm. From this graph it can be seen that there is no clear evidence of a relationship between cutting speed and feed on the one hand and wear on the other. Differences found lie in a range which is narrow enough to be explained by measuring errors and permissible dif-

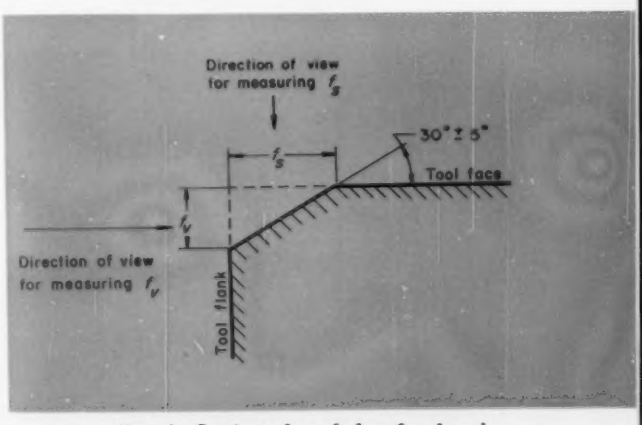

Fig. 4. Cutting edge of chamfered tool.

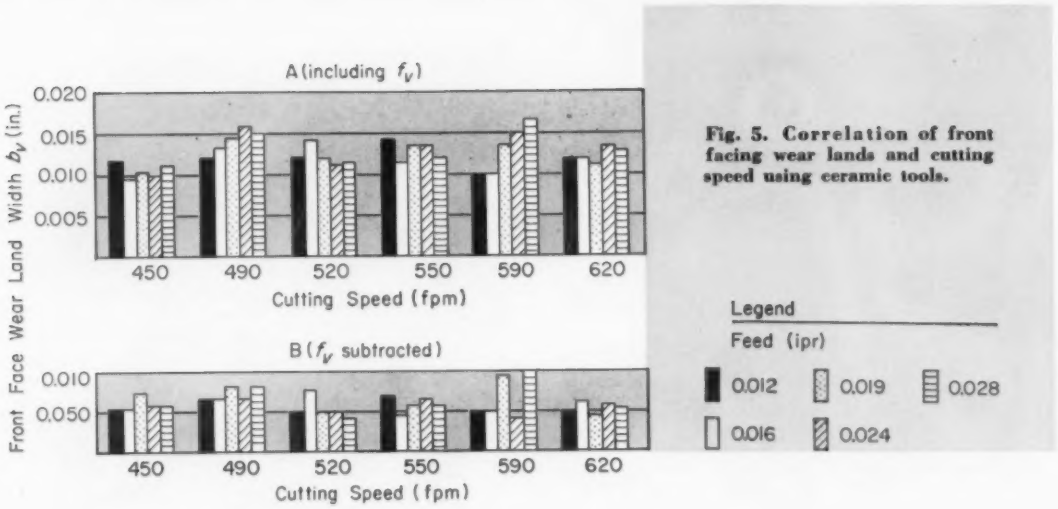

Fig. 5. Correlation of front facing wear lands and cutting speed using ceramic tools.

ferences among the individual workpieces and cutting-tool materials.

Each test was stopped after 15 minutes, because after that period of time the front face wear land showed little increase. It was, therefore, concluded that it cannot be shown that variations in the cutting conditions have a strong influence on tool life within the range which is of interest to the users of machine tools in the Netherlands.

Long Term Tests: As a matter of interest tests were made to determine front face wear land when tools were in service for more than 15 minutes. Therefore, long-term tests were carried out at cutting speeds of 460, 590 and 890 fpm, and at a depth of cut of 0.118 inch and a feed of 0.019 ipr. Under these conditions machining was continued for 60 minutes. Here too, wear at the three different speeds appeared to have variation. Moreover, the variations that did occur were contrary to what had been expected, *Fig.* 6. The test carried out at a cutting speed of 590 fpm was therefore continued for another 180 minutes. The tool used in this test thus had been used for 240 minutes. In *Fig.* 7, wear at the nose and the front face wear land are shown. It is clearly seen that at this stage of the test these two forms of wear are not yet critical. The formation of grooves at the point of contact with the surface layer of the workpiece had to be taken as a criterion. At that stage all known forms of wear, i.e., front face wear land, end face wear (the so-called "Pekelharing phenomenon") and cratering showed, but none of them were serious. Neither the front face wear land nor the nose wear land amounted to more than 0.016 inch. At the groove in the front face only 0.051 inch of wear could be measured. Cratering turned out to be of very little importance at this stage. The maximum depth of the crater measured after 240 minutes was 55 microns.

Cutting Diagram: From these tests the conclusion was drawn that, provided it was used on cast iron, ceramic material was definitely of interest to industry. It was therefore decided to draw up a cutting diagram, *Fig.* 8, for ceramic and carbide cutting tools. Starting from a tool life of 60 minutes, at a front face wear land of 0.197 inch, or a groove formation of more than 0.0394 inch, a cutting speed

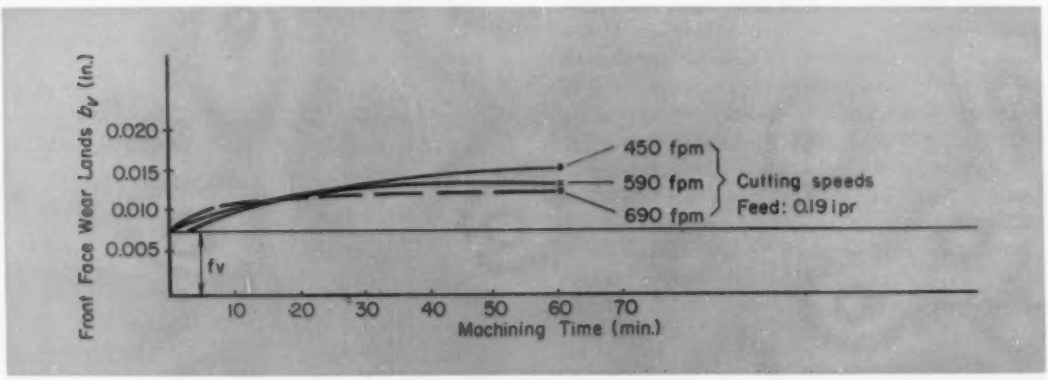

Fig. 6. Results of long-duration tests.

line for ceramic material was determined for a good-quality cutting tool. This cutting tool had a negative side rake angle of 5.2 deg, a negative back rake angle of 4.9 deg, a positive side relief angle of 6.9 deg and a positive end relief angle of 4.5 deg. The nose-radius was 0.05 inch and the cutting edges were chamfered in the manner as described previously. The ratio between depth of cut and feed varied between 8 and 9. The workpiece consisted of pearlitic cast iron having a hardness of about 235 Brinell. For the cutting-speed line for H-1 carbide cutting tools as shown in this diagram the same criterion for tool life as for ceramic cutting tools was used, i.e., front face wear land. In the case of the carbide tools both the side rake angle and the relief angles were 6 deg and the back angle was 0 deg. The geometry of the carbide cutting tools differed slightly from that of the ceramic cutting tools. The cutting conditions were the same as those used in the case of the ceramic cutting tools.

The cutting-speed line for ceramic cutting tools has two salient features. The slope is more pronounced than in the case of carbide cutting tools, and the line ends at a chip cross section 0.0006 sq in. The latter phenomenon is caused by the chamfered edge, which makes it undesirable to apply still lower feed values.

According to literature and judging from the results obtained in the preparatory investigations, these lower feeds can be used with cutting tools which have no chamfered edges. As the tests were, however, mainly restricted to cutting tools having chamfered edges, these small chip cross sections will not be discussed.

As remarked before, the dimensions of the ceramic cutting tools available made it difficult to realize chip cross sections of more than 0.0155 sq in. There is another good reason for not machining at these larger chip cross sections. If it should be desired to do so, the cutting speed must be lowered to less than 540 fpm, which, for several reasons, is undesirable. This is only an average value, for, depending on the quality of the ceramic material used, the minimum permissible speed varies between 330 and 460 fpm. It also depends on the force to which the cutting tool is subjected. If the cutting tool is not fully loaded because of insufficient power of the lathe, machining can be carried out successfully at speeds of as low as about 360 fpm. The conclusion is that for a 20-hp lathe and a chip cross section up to 0.009 sq in. a ceramic cutting tool is preferred to a carbide cutting tool.

If the chip cross section is increased still further, the cutting speed decreases to so low a value that there is a risk of fracture. From the cutting-speed lines in the diagram in *Fig.* 1, from the line for the main cutting force, obtained from literature and from unpublished work, and with the aid of the formula

$$N = \frac{P_s V}{10.5\ (60)}$$

where:

N = Net horsepower
P_s = Main tangential cutting force, in pounds
V = Cutting speed, in fpm

the net horsepower can be calculated which is needed to load both the carbide cutting tool and the ceramic cutting tool in such a way that a tool life of exactly 60 minutes is obtained.

The above formula can also be used to determine the optimum cutting speed at which a lathe of a particular horsepower can still cut a particular chip cross section.

$$V_{max} = \frac{530\ N}{P_s}$$

With the aid of the second formula speed lines can be found for speeds at which a constant horsepower is needed (lathe cutting speed lines).

From the diagram thus obtained it can be seen at which cutting speed and using which cutting tool a particular chip cross section can be taken and

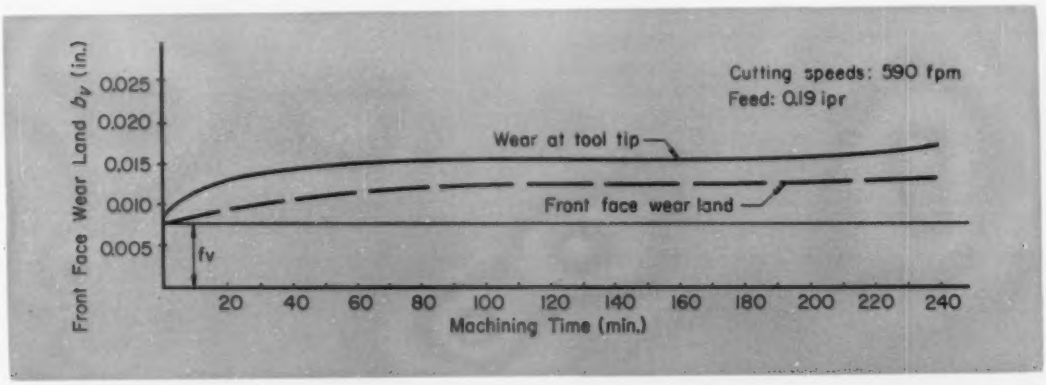

Fig. 7. Results of long-duration tests. After 240 minutes wear did not become critical.

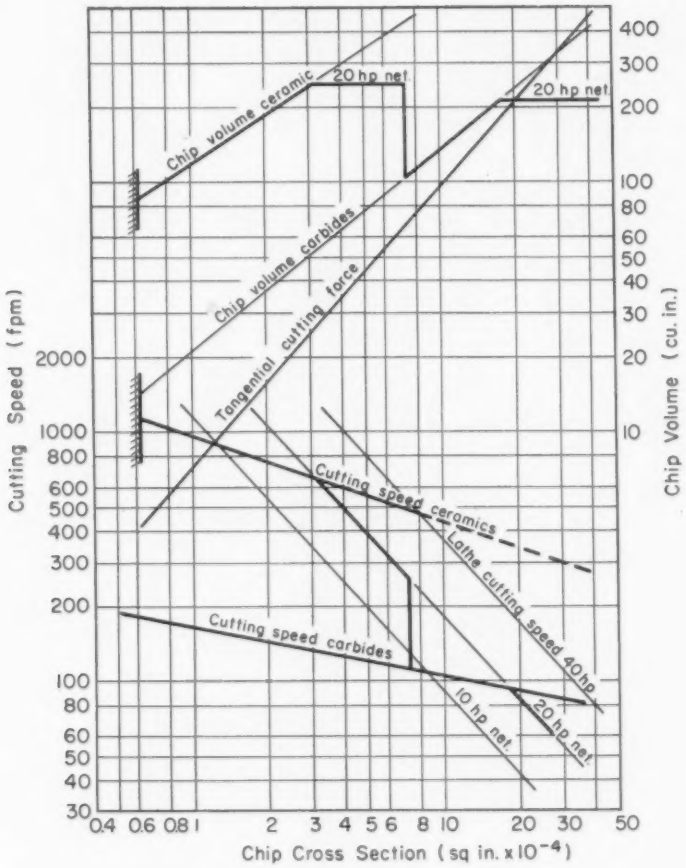

Fig. 8. Cutting diagram for ceramic and carbide tools at tool life of 60 minutes. Net horsepower is used.

how long a tool life can be expected. On the cutting speed lines tool life will invariably be 60 minutes, but on the lathe cutting speed lines it may be considerably longer. It should be noted that this graph, in contradistinction to the one in *Fig.* 1, is based on net horsepower. This fact should be taken into account when cutting conditions are chosen.

On the graph a boundary line has been drawn to denote the cutting speed and cutting tool material to be used on a lathe having a net power of 20 hp. The shaded line in the diagram represents the chip volumes obtained at various chip cross sections when a lathe of this power is used. This line incorporates both ceramic and carbide cutting tools, and is derived from the above mentioned cutting speed line (boundary line).

The author expresses gratitude to prof. ir. A. J. Pekelharing, who is in charge of the Laboratory for Metal Processing of the Technological University, and to his staff for their assistance. He also expresses special appreciation to Mr. Th. J. A. Cornelissen of the Center for Metalworking T.N.O., who carried out the investigation with other members of the staff at the center.

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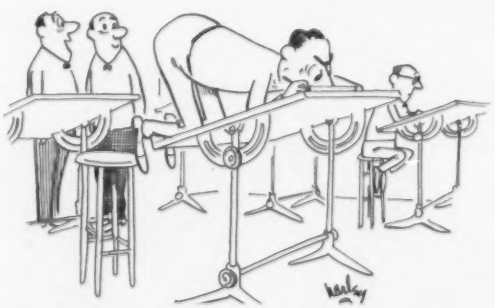


"Looks like Nesbitt forgot his glasses again."

ASTME news

Ann Arbor Member Solves Heart Surgery Problem

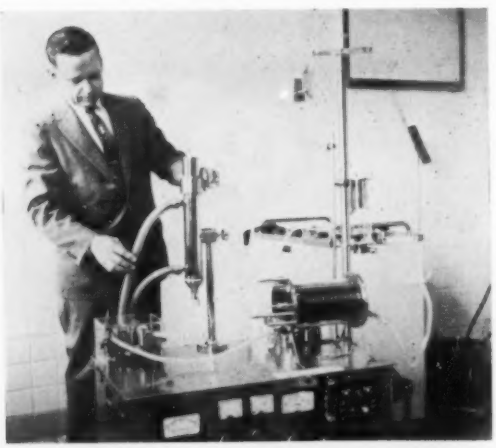
By Elizabeth R. Rooney
Assistant News Editor

A CALL FOR HELP directed at tool engineers throughout the country has received one of its first and probably most significant replies right from the distress area—Ann Arbor, Mich.

Now nationwide, the appeal, made by a cardiovascular research group, was first heard by Detroit and Ann Arbor ASTME members—and first published in THE TOOL ENGINEER last May. The engineers had been summoned to a medical-engineering forum at St. Joseph Mercy Hospital in Ann Arbor in hopes they would lend their specialized assistance to medical men in developing new tools and devices necessary for the modern techniques used in heart surgery today.

After hearing the problems as they were set forth by Dr. Clarence E. Crook, president of the Cardio-Vascular Research Association, at least one man, Therlo W. Lawrence, went home from the hospital conference room and began work on what turned out to be a nine-month project. After months of working on the device and months of conferring with the doctors, he had the answer. His apparatus was used successfully in an operation on a human.

Lawrence's combination heat exchanger and bubble trap, in the words of Dr. Crook, is a "superb instrument." Open heart operations and treatment of brain injuries will be made safer because of it. The combined unit is used for controlling the temperature of circulating blood during surgery and for removing dangerous air bubbles. According to the doctors the instrument will be useful when it is necessary to lower the body temperature during surgical treatment of specific types of heart conditions, in treatment of diseases and injuries that cause rising fevers and damage to the brain or limbs.



Therlo W. Lawrence, a tool engineer at the King-Seeley Corp. in Ann Arbor, demonstrates how his combination heat exchanger and bubble trap is connected to the pump of a heart-lung machine and a baby type oxygenerator before use in surgery.

The heat exchanger and bubble trap is a chrome-plated brass cylinder or water jacket, having a diameter of 3½ inches and a height of 18 inches. The water jacket contains 19 stainless steel tubes with very thin walls. The tubes stand vertically beginning at the bottom of the jacket in a funnel-shaped chamber. Blood is pumped in from the chamber through the steel tubes as water, introduced through the lower end of the cylinder, surrounds the tubes. As the temperature of the encasing water is raised or lowered, so too is that of the blood passing through the tubes.

The blood then proceeds directly into the bubble trap from the top of the heat exchanger and rises through a vertical trumpet-shaped tube. Separation of air bubbles occurs when the blood passes slowly over the trumpet's rim and the bubbles escape to the top of the chamber where they can be drawn off in an attached syringe. Through an outlet the blood then goes back to the patient after having flowed over the trumpet rim to the floor of the trap.

In open-heart surgery where a heart-lung machine is used, a unit circulating the blood is indispensable. Blood taken from the patient flows by gravity into a settling chamber and then into the oxygenerator. After oxygen has been supplied a pump takes it from there to the heat exchanger and bubble trap back to the patient.

Despite Ann Arbor chapter member Lawrence's work the slate of problems existing in the medical engineering field today can still only be wiped partially clean. But other tool engineers in all parts of the country have become acquainted with these problems and, according to the Ann Arbor doctors, a number of other projects being conducted by equally dedicated men are now underway and some are nearing completion. Evidently the challenge to turn their attention away from the toolroom to the operating room for a time has not proven too great for certain humanitarian-minded ASTME members.

Addition to Society Name Wins by Big Majority

ADDITION of "and Manufacturing" to the Society's title—making it the American Society of Tool and Manufacturing Engineers—has been approved by a 7½-to-one majority of votes cast by the membership.

The change became effective Jan. 7, immediately after expiration of the 30 days set aside under the Constitution for the referendum.

"Properly and accurately we have not changed our name," declared Executive Secretary Harry E. Conrad. "We've only added to it, so as to more accurately reflect the membership which the Society serves.

"There should be no great rush in effecting the physical changes necessary, no upsetting of apple carts. We will still be known as tool engineers for years to come. We're still the same Society, still an organization of 40,000 individuals with common interests, dedicated to furthering the science of manufacturing."

Conrad emphasized that the Society's physical transition from ASTE to ASTME would be deliberate but gradual, for the sake of economy. Insofar as it is sensible to do so, Society Headquarters and chapters will make use of existing supplies of printed materials, awards, emblems, pins, and so on, carrying the incomplete name or initials of ASTE. Stickers explaining the addition to the title, to be affixed to letterheads, billheads, brochures and leaflets that are already in stock, will be furnished to staff and chapter officials.

What about the sign over the entrance to 10700 Puritan Avenue, the two-foot-high stainless steel letters spelling out American Society of Tool Engineers?

"The sign will come down, in due time," Conrad said. "But—in the interests of economy again—a modest plaque will go up in its stead."

The ramifications of such a change are staggering. Aside from the reams of papers, thousands of lapel pins and hundreds of banners and other emblems, there are countless entries in telephone books, almanacs, engineering digests, encyclopedias—and, many will add, in memories!

Someone expressed concern, too, for the more enthusiastic boosters who have racks full of "ASTE" ties—and another wag was wondering whether any members would need to have tattoos removed.

Evidences of the new name blossomed forthwith, among the earliest being the revised symbol appearing with this article and the revamped cover page to this month's ASTME News section.

Indicative of the high interest of the membership in the addition-to-the-name proposal was the amazing response to the referendum. The total returns represented better than 47 percent of the Society's membership, which is a salutory expression of opinion in any democratic organization.

Along with many of the ballots came comments, most of them laudatory, some critical, some suggestive, some humorous. One voter who sent a covering letter along with his ballot addressed himself to "Dear Fellow Nutcracker. . . ."

A dozen years of study and debate preceded the latest move to alter the Society's title. Past efforts to change the name have been unsuccessful in large measure because they have proposed dropping the tradition-laden words "tool engineer." The Society's present leaders, however, sitting as the Long-Range Planning Committee, recommended that the name be expanded, rather than changed, as a realistic compromise to the problem.

Following the procedure stipulated by the Constitution, the next step was obtaining of 400 or more signatures of eligible voting members. Then came approval of a referendum on the proposal by a majority of the chapter Constitution and Bylaws committees. Ballots were mailed to the membership on Dec. 7.

Perhaps Editor John W. Greve of THE TOOL ENGINEER placed the addition to the name in its proper perspective when he wrote in his December editorial:

"Whatever the title, the job of the tool engineer remains the same: Use the latest and best method, technique or process to build the best product at the lowest cost and for the most customers."

The Society's leaders are convinced that the expanded name will better convey to the public, to industry, to educators, and even to the members themselves, the broad function and importance of tool engineering in its 1960 setting. A big majority of the members seems convinced too.

17 Plant Tours Scheduled

In a metropolitan area containing 6221 factories, there will be no shortage of plant tours for the ASTME's Engineering Conference in Detroit April 21-28.

Seventeen formal tours have been tentatively scheduled. Hours, days, places of bus departure and return, and details of what will be seen on the tours will appear in the printed programs.

One of the most unusual tours will have an international tang. During a half-day visit across the river and under the ground, visitors will see a 32-acre city of solid rock salt at the Ojibway Salt Mines near Windsor, Ont. Fifty-foot-wide streets 1085 feet beneath the surface are kept in condition by standard power road graders. Salt is handled by endless belts and 12-ton dump trucks with balloon tires which carry the material to crushers. At the present production rate of 500 tons an hour, or one million tons per year, the present mine will last more than a century.

Another tour will take registrants to Ann Arbor, where they will see one of the few photographic lens grinding, polishing and centering facilities in the United States. Argus Cameras' lenses are measured in the millionths—yet can reach a top production rate of 18,000 per day.

Other plants on the tour schedule include:

The "Rouge"—Ford Motor Co.'s colossal integrated facilities in Dearborn.

GM Technical Center—the new technological and architectural landmark just north of the city.

Ex-Cell-O Corp.—manufacturer of broaches, cutting tools, thread grinders, tape-controlled machines, and so on.

Chrysler Corp. of Canada—one of the most modern composite auto plants, covering 30 acres and containing over 7½ miles of conveyors.

Detroit Diesel Engine Div., GM—featuring the latest in transfer machines.

Chrysler Trenton Engine plant—10 different engines are built to 159 modifications and assembled on only two lines.

Ford Motor's Tool and Die building and Rotunda.

Chevrolet Motor Div., Willow Run plant—new techniques in assembly of rear-engine model.

Enrico Fermi atomic energy plant.

Burroughs Corp., Plymouth Mfg. and Engr. Div.—displaying a unit manufacturing theory whereby subunits are completely built in individual departments, transported to the assembly line and installed in one operation.

Chrysler Corp., Mound Road plant—V-8 engine plant producing 150 engines per hour.

Ford Sterling plant—transmission and chassis production.

Great Lakes Steel Co.—hot strip rolling.

Dominating the landscaped flatlands of the General Motors Technical Center is this 132-foot water tower sheathed in stainless steel. At the rear is the aluminum-clad dome of the GM styling auditorium, partially screened by a 115-foot water curtain thrown up in an artifical lake. Convention visitors will visit the center. Cameras are welcome.

Detroit Engineering Conference visitors will have an opportunity to visit the Ex-Cell-O Corp. This is the assembly area for Pure-Pak milk-packaging machines in the Hamilton Avenue plant.

Director of the Society research project on punchability, Prof. John E. Biegel, checks the microhardness of a punched slug in lab at Syracuse University.

society sponsors

Research on Punchability

By M. L. Stone
News Editor

TO MANY TOOL and manufacturing engineers, research is likely to be a highfalutin word, a green-cheese concept, about as far removed from the workbench as the moon.

That's not so far any more. And it's getting closer by the day, as close as places like Syracuse.

There, on the 87-year-old campus of Syracuse University, under the dispassionate eyes of half a dozen experts who have no axes to grind, a new Bliss Model 625 press is punching out slugs by the thousands. The slugs—from various stocks of electrical steels—are collected in magazines in the order of punching. At carefully counted intervals, silence reigns while a battery of complex measuring devices amasses data on every conceivable variable in the slug, the punch, the die, the press, the lubricant. . . .

The ASTME Research Fund has expressed its willingness to gamble $25,000 and 13 months of wait-and-see that the silences will be golden. Out of them, the Fund, through its Metal Stamping Project Steering Committee, hopes to evolve and disseminate some sorely needed knowledge on the science of the art of metal stamping. Specifically, in this first skirmish of a long-term attack on stamping problems, the Research Fund Committee is seeking information to justify "Development of a Punchability Rating Method for Electrical Steels."

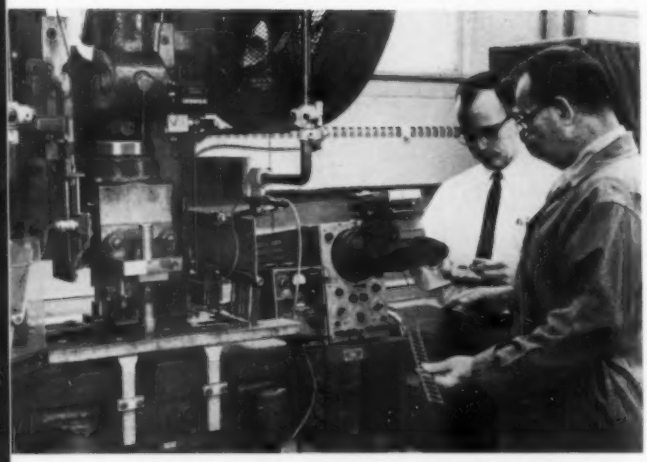
The distinguishing characteristic of research is implied in that project title. The Society has not asked the university researchers to report the punchability rating of any electrical steel, but rather to see if there is a *method* of measuring punchability of electrical steels. Research aims only at discovering new knowledge; application of the new knowledge is an economic by-product.

Variables Complicate Picture

Research is always a painstaking business, and especially so when it is bent toward a field as broad and complex as metal stamping. As the Fund stated in its request for proposals:

"Stampings vary from small simple stampings to large complex ones. The material stamped varies from plain cold-rolled, low-carbon steel to heat-treated high-alloy steel and includes nonferrous metals such as titanium. The presses used vary in size, condition, age and speed. The dies used may be simple or complex, carbon steel, alloy steel or carbide. Shop practices seemingly have no end to their variations. The criteria for acceptable stampings vary over wide ranges. The lubrication techniques vary from no lubricant to very complex lubrication practices. Die design appears to be an art rather than a science.

"The net result of this lack of basic understanding of the metal-stamping process is trouble. The die designer and the diemaker have no assurance that they will be successful. The shop has no assurance that a job will start successfully, nor have they any assurance that, once started, it will continue to run successfully. The material producer



Graduate assistant Stacy Rowley and Edward Skowron of S.U.'s Metals Processing Lab scan strip and punchings from punch press dynamometer dies. Oscilloscope and recording camera are connected to strain gages on punch dynamometer. Determining methods of testing and measuring the parameters in the punchability study, plus designing or modifying instrumentation, are a big part of the research.

has no assurance that his material will run successfully in the shop. . . ."

Current hit-or-miss practices have given rise to informal standards on such aspects as press strength, clearance, rigidity, stripping action, speeds and lubricants. New steels, new die materials, new die designs, have rendered this empirical data inadequate for production in the electrifying era of the Fifties and the Sixties.

In the interests of common sense, the Research Fund narrowed its initial search for new knowledge to electrical steels. Why were electrical steels chosen?

Significance of Electrical Steels

Electrical steel was selected from the stamping spectrum because the trend toward high-production use of finished and semifinished coil stock has compounded the usual punchability problems. The hard steels used in the production of large numbers of motor and transformer laminations cause more wear on punches and dies. Further, burrs in these high-silicon materials are liable to cause electrical shorts when they are put into use. Adding interest to the electrical steel problems are their economic significance—a million tons costing $280 million are consumed yearly for this purpose—and the high degree of automated equipment in the field. These implications were cited in a special Research Report outlining the metal stamping project, written for ASTME by Hunt Gwyn and Edward Griffiths, retired director of expense control, tools and equipment manufacturing, Westinghouse Corp.

Syracuse University was chosen to do the research because it submitted the best bid in terms of understanding of the project, of equipment to carry it out, of research brains—and of dollars.

S.U.'s industrial engineering setup is relatively new and modest but excellent—so excellent within its $75,000 operating budget, in fact, that 14 other universities have sent men to see how they do it. Undergraduate enrollment is about 40. The faculty consists of three full professors, one associate and two assistants; in addition, the invaluable counsel of an international metallurgical expert, Dr. George Sachs, who is associate director of S.U.'s Research Institute, is available to the department. Equipment with an original cost of a quarter of a million includes production machines, toolmaking machines, welding, foundry, forge, metallurgical equipment and a quite complete range of measuring and recording devices. There are also a Burroughs 101 and an I.B.M. 650 computer in Hinds Hall, the new nucleus of Syracuse University's engineering college cluster.

The ASTME punchability project is under the direction of Asst. Prof. John E. Biegel, a Montana State and Stanford graduate who has had considerable experience in metal processing and especially in the application of statistics to industrial processes. Biegel is giving 50 percent of his time to the Society research and Department Chairman Bert H. Norem has earmarked 15 percent of his day.

University researchers are working on other projects besides the Society's. Here, studying a half scale compressor disk forging made by the radial extrusion process, are Edward Skowron, Prof. John Biegel and Prof. Bryce Genzlinger, who is directing this research. To date the project has developed a process that reduced the forging force by 50 percent and resulted in a forging that is only 125 percent of the weight of the finished part. Tolerances on the as-forged part are held within a very few thousandths.

The project was set up by Syracuse, and approved by the Metal Stamping Steering Committee, in four phases:

1. Survey of literature
2. Establishment of a test procedure and the design and preliminary testing of new equipment
3. Building of the basic "punchability" unit and a trial run to determine the feasibility of its use
4. Running a series of tests to establish the validity of the test procedure and test equipment, and an evaluation of the resulting data to determine recommendations for further research.

Biegel is currently in Phase 3. The timetable calls for completion of the final phase by July 31, 1960, with the final report by the end of August.

Industries Are Vitally Interested

Although applied-basic or basic research such as the Society sponsors is not in competition with industry, as Research Director Leslie S. Fletcher emphasizes, that does not mean that industry is not vitally concerned.

Industry's concern with the metal-stamping investigation is signified by the fact that 64 companies or independent divisions of large companies are represented on the Metal Stamping Project Steering Committee by 87 persons. Recently named chairman of the Steering Committee, replacing R. J. Gargrave of Dayton Perforators, Inc., was S. B. Fuerst, consultant, Manufacturing Engineering Research, General Electric Co., Schenectady.

Interest in the over-all stamping research project is dramatized by the fact that during 1957 and 1958, attendance at Steering Committee meetings reached 659, averaging 80 percent of the entire membership. Members are appointed by Fletcher on the basis of their authoritativeness in the field and their current interest.

It was essential for the researchers to determine punch and die wear without press variability, and industry again showed its cooperative interest. The E. W. Bliss Co. offered the use of its new Model 625 press, with a variable speed drive and a double-roll feed, for six months starting in January. The same press is scheduled to go on display at the National Machine Tool Builders show in Chicago next fall. Other companies are furnishing die sets, stocks of steel, and cash.

Still there is not enough cash to buy the research more than one phase at a time. This piecemeal approach leads to planning difficulties for university researchers—work is built around curricula and around permanent, not part-time, people. "If only all sponsors wanted their research projects started in the summer or at the beginning of a semester—and could let us know well beforehand—our search for the 'why' wouldn't be complicated by interim searches for the 'how,'" as Biegel put it.

Nevertheless, work does progress and results do appear, as witness the Society's just-published Research Report No. 26—Biegel's "Final Report Phase 1" on the punchability project. It is available—and its successors will be—from Society Headquarters, 10700 Puritan Ave., Detroit 38.

Metalworking Expert with Chip on Shoulder

The head of Syracuse University's six-man industrial engineering department, a metalworking expert with world-wide academic and industrial consulting experience, carries a chip on his shoulder. Bert Norem is convinced that the research dollar will stretch the farthest when it is expended in university laboratories, and is indignant that so few organizations and industries seem to realize this.

With some mettle, he declares:

"On the campus there's no overtime; overhead is low and often largely absorbed by the institution; labor is cheap; brains are usually in some abundance. But most important—motivations are unclouded by a desire to develop a moneymaker for stockholders. Universities demand freedom to find *all* the answers, instead of just the answers pertinent to a piece of hardware."

Norem is grateful for projects such as ASTME assigned his department because they abet his university's reason-for-being—to train young engineers. From the long-term view, he believes, high-level research by universities may benefit industry and government more than the actual research results, in terms of the training it gives to students.

So much expensive equipment is needed to educate the engineer nowadays that no private university, at least, can afford it without industry or government or society subsidization, Prof. Norem says.

"The hue and cry about inability to pay the cost of higher education has a hollow ring. If 50 percent of government research alone were earmarked for universities, we could support all the technical education in the country and support it well."

Norem is apt to criticize organizations who are so ready to give a few scholarships, but nothing else, to the universities. "It costs a university $3000 a year to educate a student. So the university *loses* money when it gets a scholarship student. It would much rather—from a selfish monetary viewpoint—that a research grant in the same amount went along with the scholarship."

The danger of too much campus emphasis on research, he admits, is that universities will become the underpaid R&D lackeys of industry.

Members in the News

E. S. Phillips

EDWIN S. PHILLIPS, past chairman of Pittsburgh chapter and president of the E. S. Phillips Co., has been named sales and service representative of the N. A. Woodworth Co. An authority on cutting tools and workholding equipment, Phillips has written articles for machining and plastics publications and is a field editor for THE TOOL ENGINEER. Phillips' organization will service the Southwestern Pennsylvania and West Virginia areas.

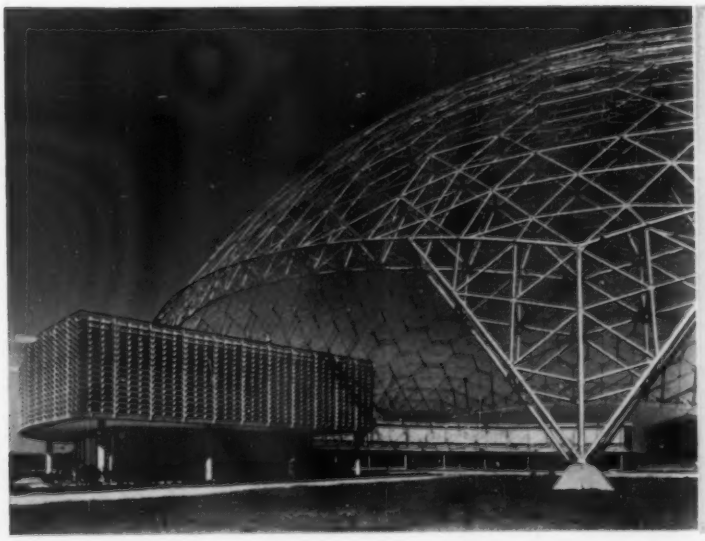
DUDLEY WILLIS ROCKWELL has been elected president of The Stanley P. Rockwell Co., succeeding William A. Stumpf, who recently died. Son of the founder of the company, Stanley P. Rockwell, who was the inventor of the Rockwell hardness tester, Rockwell, a Boston ASTE chapter member, has been active for 23 years as a metallurgist and vice president in charge of sales.

THORWALD S. ROSS, Boston member, has been promoted to vice president in charge of manufacturing with the Rivett Lathe & Grinder, Inc. . . . Several organizational changes were made at H. K. Porter, Inc., among which was the election of FRANCIS T. LIND, Boston, to executive vice president. . . . JACK H. SCHRON of Cleveland chapter has been moved up from vice president of manufacturing to president of Jergens Tool Specialty Co.

RUSSELL L. BEARSS of Detroit chapter has been named manufacturing engineering manager of the New Process Gear Div. at Syracuse. Bearss was, prior to his new assignment, manufacturing engineering manager for the corporation's Engine Div.

ROBERT L. SISSON, Canton chapter member, has been appointed general superintendent of the Canton and Gambrinus bearing factories of the Timken Roller Bearing Co. Sisson started with the company in 1937 and has advanced successively from assistant foreman to his present assignment. . . . With 20 years' experience in hydraulic press design, M. E. Lawrence, Chicago chapter, has been appointed manager of the Machinery Div. of Parker Hannifin Corp. . . . Cone Automatic Machine Co. has announced the appointment of ROBERT R. RHODEHAMEL as general manager. A veteran in the metalworking industry, Rhodehamel has been, until recently, vice president of the Patt Brothers Machinery Co. of Willoughby, Ohio.

Symbol of New Era in Metals



Many ASTME members attended the recent ceremonies dedicating the imaginative new headquarters of the American Society for Metals in suburban Cleveland, Ohio. Shown here in striking detail is one of five pylons which support the 103-foot-high geodesic dome that arches over the semicircular building. The ASM headquarters symbolizes "how metals can be bent to man's use through science and engineering," according to Managing Director Allan Ray Putnam.

Glen Underwood (left), membership data processing supervisor at Society Headquarters, takes mental notes as Directory Editor Dan Dallas discusses with his assistant Patricia Libel the products checked by various manufacturers to appear in the 1960 *Suppliers Directory*. Underwood's department is using IBM to process the directory's product and manufacturer listings.

New Directory Taking Shape

As TOOL ENGINEERS and manufacturers, readers of THE TOOL ENGINEER are a big part of a big project—the *Suppliers Directory* which will appear in the June 15 issue of the magazine. From why to what to how, every facet of this project has a significant, valuable meaning for the key men in the metalworking industry—for you.

Why is there a *Suppliers Directory?* Because tool and manufacturing engineers need it. In a year-long study A. T. Kearney & Co., management engineering consultants, determined the field's need for a complete product information service; the result was a national directory of local sources, the 1959 *Suppliers Directory*. But the directory is no more static than the need it answers. It is a dynamic, growing, up-to-date service—and that's the "why" of the 1960 issue.

Due to the success of the first directory and the fact that thousands are now familiar with its convenient system, the "what" of the new 1960 directory will be basically the same as the features of its predecessor. They are features custom made for the men who create, improve and expand the ways and means of efficient production: an alphabetical listing of the products that tool and manufacturing engineers specify, recommend and put to use; the names and addresses of the companies who manufacture these products; a geographical listing giving the names, addresses and telephone numbers of these manufacturers' local sources; and technical articles with special pertinence to tool and manufacturing engineering.

Convenience is a prime factor in the directory because it enables the user to reap the full harvest of information planted there. Color-coded sections are arranged for step-by-step procedure. Cross-indexing takes the guesswork out of reference to a product or manufacturer. The size is first-class for handling.

Over and above a cumulation of striking features from the first issue, the new directory will have its own individual highlights. Beneath a new and distinctive cover will be listed up to 20 percent more products, manufacturers and local sources than in the 1959 directory. Despite expansion, effective handling will be safeguarded by dividing pages into four instead of three columns, which prevents added thickness and weight.

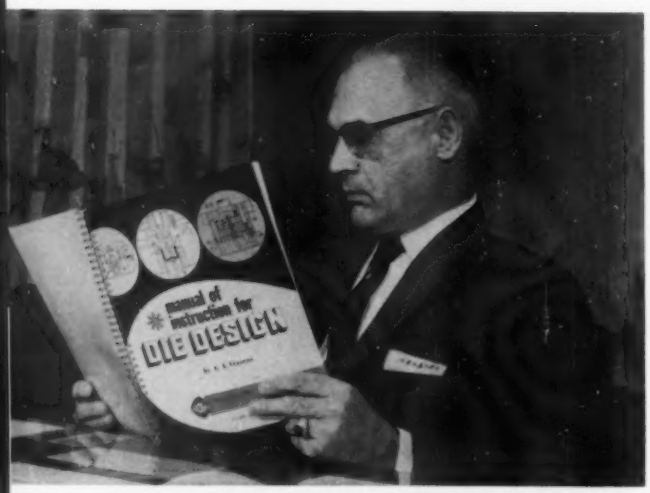
How is the directory being compiled? With every possible consideration for the men who will use it. To insure authoritative information, forms are sent direct to the manufacturer. When the data is returned, every attempt is made to facilitate accuracy in processing it. For example, IBM is being used, for the first time, to tabulate both the products and manufacturers sections.

The greatest care is taken to obtain an accurate and complete list of manufacturers. Although the mailing list is continually growing, it is inevitable that some names may be overlooked. The staff doubly regrets these oversights when they pertain to a company in which some employees are ASTME members.

The editors would appreciate being informed if a member noticed that his company is not listed in the 1959 directory.

In such a case, please send the following information to the Directory Editor at Society Headquarters: the name and address of the company, the name and title of the person to contact for official information, and the names of the products manufactured for sale of the type specified by tool engineers.

Manual for Die Design Published by Society



Casting a critical eye over the newly published *Manual of Instruction for Die Design* during a visit to Headquarters is Prof. A. A. Vezzani of the University of Michigan. Vezzani is well qualified to be critical, being one of the Midwest's leading authorities on die design—and being the author of the manual.

A LEADING AUTHORITY on die design and one of the country's best teachers of the subject, A. A. Vezzani of the University of Michigan, has distilled his 35 years' experience into an excellent manual for tool and manufacturing engineers.

Published by the Society's National Education Committee, "Al" Vezzani's book—the *Manual of Instruction for Die Design*—was designed specifically to be used in conjunction with the comprehensive *Die Design Handbook* which the Society Book Committee compiled five years ago. The new manual should be just the ticket—the up-to-now missing ticket—for chapters that wish to offer instruction in die design, or for the student who wants to help himself in a home-study program.

The 210-page, spiral-bound manual covers the use, construction and design of blanking, compound, forming, combination, progressive, draw, trim and cam dies. In addition it contains information on presses and their selection, on die materials and equipment, safety, production factors and costs.

Along with the *Handbook* and with Russell Cory's two-part *Die Design Manual*, Vezzani's work will form the nucleus of the die design courses that have proved successful on a pilot basis and are being encouraged by the National Education Committee as chapter-sponsored projects.

In a home-study program, the individual student may follow the instructions given in each problem and, with the assistance of the references, work out each design. At his own discretion he may gain either a working knowledge of die design and the problems of die designers, to help him in his duties as tool or manufacturing engineer or other position; or pursue the course to mastery.

Vezzani, who is an associate professor of industrial education at U of M and a member of Ann Arbor chapter, brought more than theoretical experience to his authorship. As a co-op engineer in diemaking and die design at the Chevrolet Motor Co. in Flint from 1924 to 1930, he worked on all toolroom machines, on the bench as a group leader, and in the drafting room as a designer. Thereupon followed nine years of teaching tool and die design to high school students and five years to vocational and adult education students, with summer jobs in toolmaking, die designing and managerial capacities. A master's degree holder from U of M, he joined the university staff in 1944. From 1944-54, his duties entailed primarily the development of AFL and CIO apprenticeship programs in Detroit.

The Society's new manual is a revision and expansion of an original text written by Vezzani called *Job Sheet Manual for Sheet Metal Die Design*. On the basis of experiences gained during the past ten years and of discussions with Society members, Vezzani undertook the ten-month task of writing the present manual.

Among those who assisted the author were Raymond Scott, a colleague at U of M; ASTME Education Director Gilbert E. Seeley; and members of the National Education Committee.

National Engineers Week

Many ASTME members will join their fellow engineers in other branches and organizations in observing National Engineers Week, Feb. 21 to 27. Some chapters have arranged joint meetings with other societies. The annual salute to engineers is sponsored by the National Professional Engineering Society.

14 chosen for Award of Merit

Again this year Society chapters have searched their ranks for members who they feel deserve special recognition. It's deeds that win the prize, and in this case the prize is the Award of Merit plaque and the deeds are the time and effort spent by these individuals in advancing the reputation of the American Society of Tool and Manufacturing Engineers.

Every chapter harbors a candidate for the merit award. In their nominations many of these chapters referred to their candidates as "Mr. ASTE" in that particular area. It was up to the National Honor Awards Committee, headed by Otto W. Winter, to choose 14 of the most outstanding.

The chapters whose candidates were chosen will have the honor of making the award presentations at future chapter meetings. Receiving Awards of Merit during the next year for their contributions to the Society on both the national and chapter level during the past years will be:

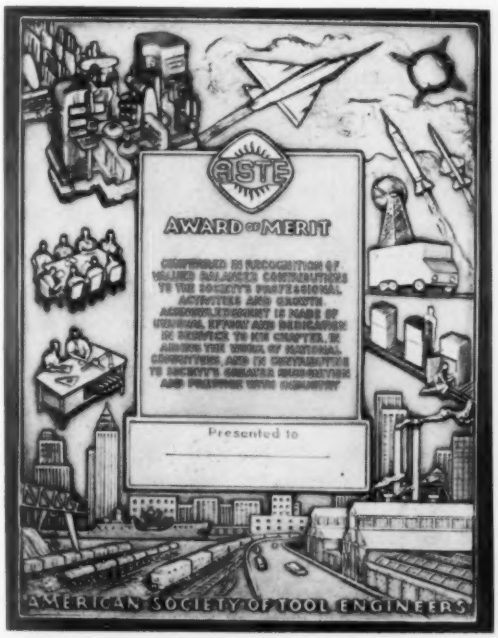
PAUL E. BUTZIN, **Milwaukee**—Chief engineer at A. O. Smith Engineering Service Corp., he has been a member of ASTE since 1936. As chapter chairman, he laid the groundwork for the chapter's scholarship program and the promotion of ASTE as a professional engineering society. From 1948 to 1953 Butzin headed the industrial relations committee; from 1953 to 1958, the historical committee, and for this same ten-year span he was chairman of the nominating committee.

GEORGE H. CHURCHILL, **Hamilton District**—Chairman of the chapter Constitution and Bylaws committee since 1951, Churchill, prior to that time, had served on just about every chapter committee, sometimes in the capacity of chairman. The owner of Churchill and Associates, consultants to the metalworking industry, he was on the National Membership Committee in 1956 and since 1957, the National Program Committee. His chapter-level activity has included the establishment of tool engineering night courses at local technical schools.

ARTHUR E. CROM, **San Diego**—Presently the chairman of the National Standards Committee, Crom is completing his fifth year with that group. He is staff assistant to the manager of manufacturing, research and development at the Convair Div. of General Dynamics. Crom was chapter chairman for two terms. During this period he increased the membership in San Diego from 40 to 220, and established the first series of tool engineering courses in conjunction with California Western University. Enrollment for these courses exceeded 200.

STANLEY C. PHILLIPS, **Detroit**—A coordinator-instructor for the Detroit Board of Education, Phillips has served the Society's largest chapter well in its relationships with students and educational activities. He received an Outstanding Service Award pin for his help in organizing student chapters at the University of Michigan, Lawrence Tech and Wayne State University. He also helped institute tool engineering courses at U of M and Lawrence, and originated two chapter scholarships. As chapter chairman in 1954, he helped build membership to 2100.

EDGAR A. DOOGAN, **St. Louis**—Now living and working in Fort Lauderdale, Fla., Doogan was the



chief organizer of the St. Louis chapter, and for its first two years, the chairman. He continued serving on various chapter committees until he retired. His interest in increasing membership resulted in the induction of some 200 new members. His assistance on the education committee lasted for 15 years during which time he promoted student educational aid and lectured before technical groups, at technical schools and universities in the St. Louis area.

RAYMOND E. GARISS, **Long Beach**—A charter member of Chapter 84, Gariss works as a senior tool design engineer at Douglas Aircraft Co. Starting in 1951 as a member of the public relations committee, he worked on various other chapter committees until 1956 when he became chapter chairman. This year he counts among his duties service on the special events committee, the on-campus conference committee and the education committee, the last of which has claimed his services for seven years. Gariss is vice chairman of the National Technical Publications Committee.

THOMAS J. GILCHRIST, **Houston**—With ASTE since 1939, Gilchrist is a charter member of the Houston chapter. He served as treasurer, secretary, first vice chairman and, in 1950, chapter chairman. He has also been chairman of several chapter committees and from 1951 through 1956 he was the chapter's delegate to the Engineers Council of Houston. For the first Annual Meeting held in his city Gilchrist was the budget chairman of the host committee. Chairman of the sessions arrangement committee was his job during the last national meeting held in Houston. He heads his own company.

JOSEPH N. HUSER, **Indianapolis**—President of the B & H Tool & Machine Corp., Huser has four sons, all of whom are ASTE members. He was chairman of his chapter during the 1944-45 term. As public relations chairman in 1942, he was the editor and originator of Indianapolis chapter's first monthly bulletin. He boosted the chapter's membership during his year as chairman of the membership committee. Ties between local industry and his ASTE chapter were strengthened when Huser took over the industrial relations committee in 1948.

E. WAYNE KAY, **Macomb**—Kay has been affiliated with two ASTE chapters during his years with the Society. He joined the Detroit chapter in 1943 and two years later, after serving as program and first vice chairman, he became chairman. While with the Detroit chapter, Kay was chairman of the National Editorial Committee. His work in 1955 resulted in obtaining a sufficient number of new members so that a charter could be granted the Macomb chapter of ASTE, of which he is now a member. Kay is also a sectional chairman of the 1960 Detroit host committee. He is president and owner of the Raaballoy Corp. of East Detroit, Mich.

HENRY E. KURYLA, **Hartford**—A member of the National Program Committee for two years, Kuryla is a past chairman of Chapter 7. During his years as a chapter officer he concentrated on increasing the attendance at the monthly meetings. Two of his years with Hartford have been spent as chairman of the membership committee, and a year each as chairman of the program, affiliate membership and Connecticut Day committees. Kuryla is a tool lesign engineer at Connecticut Tool Design Service.

RICHARD LAUTERBACH, **Mohawk Valley**—Six of Chapter 78's committees have benefited from this man's chairmanship—the program, public relations, editorial, membership, education and standards. He was also first and second vice chairman before taking over the chapter chairman's post. Lauterbach served as chairman of the automation seminar which was sponsored by the Mohawk Valley chapter and the Mohawk Valley Technical Institute. He is general supervisor at Horrocks Ibbotson Mfg. Co.

HARRY J. MOFFATT, **Louis Joliet**—A past chairman of both Decatur and his present chapter, Moffatt is usually referred to as the father of Louis Joliet Chapter 104. He headed it in 1953. A veteran of many program committees, Moffatt is called on perennially for his organizing talents—and perennially and tirelessly renders them. He has served on the National Standards Committee; in work with the American Standards Association he has served as chairman of ASA's technical committees on twist drills and jig bushings. He is tool and supply superintendent at the Caterpillar Tractor Co.

CHARLES W. SCHEIHING, **Cleveland**—A vice president of the Producto Corp., Scheihing has been actively engaged in promoting and assisting in tool and die apprenticeship training programs. Scheihing is a pioneer in a pioneer chapter: he was a chapter-elected officer from 1937 through 1943, with the last year as chairman. Since then he has served on many chapter committees and on the National Education Committee.

ALBERT M. SCHMIT, **Toledo**—Schmit joined the ASTE in March, 1937. A past national secretary and director, he is at the chapter level the "godfather" of all his chapter's chairmen. He headed Toledo chapter's professional engineering committee and has as well worked on several national committees.

The Human Element in Metalworking...

". . . Too often we tend to think just in terms of the end product. The tool engineer has the particular responsibility to take into account the people involved in producing the product. . . . It becomes a necessity to match the tool concept to the available labor skill. We must know the kind of labor supply available in our area and shop. We don't tool for old German mechanics the same way we would for young high school boys just off the tobacco farm—or do we?

"We must learn to talk with people, on the shop level on one hand and on the erudite level of the long-hair developer on the other, in order to bring understanding between the two."

This challenge to tool and manufacturing engineers was contained in a sparkling banquet address at mid-point of the two-day Tooling and Manufacturing Conference at North Carolina State College. The speaker was J. Harold Moore, works manager of the Western Electric Co. plant in Winston-Salem.

Moore confined his discussion of the "human element" to the human need for satisfying work.

Out of four in-plant discussion sessions with tool engineers, Moore culled some problems which he assumed were prevalent in other companies.

Among those he listed for his ASTME audience were poor paper work, unnecessarily tight tolerances, inferior operation sheets, paper-designed tools without the proper experience or experiment behind them, failure to evaluate the suggestions of employees. All of them play hob with the human element, he said.

A mutual problem of engineering schools and the metalworking industry is to bridge the gap between theory and practice, to take into account the human being in every situation, Moore declared. As one effort to sensitize engineers to this problem, he described a rotational program for young tool engineers, enabling them to study methods and people from all perspectives.

Carolina Conference Draws 327

PIEDMONT CHAPTER and its proteges—Raleigh-Durham, Bristol and Gaston Tech student chapter—have built an on-campus conference into a going concern in the space of two years. Evidence of this overflowed on the campus of North Carolina State College recently, when 327 registrants and many more exhibit sightseers turned out for the second annual two-day Tooling and Manufacturing Conference.

The national organization paid appropriate recognition to this success, too, for among those who showed up at the conference was President Wayne Ewing. He addressed the windup luncheon meeting on "Tool Engineering—Today and Tomorrow."

"Manufacturing Procedures in the Metalworking Industries" was the theme. Technical session subjects included cutting tool geometry, bending of tubes and structural shapes, principles of heat treating, grinding wheel bonds, R&D on drilling, developments in barrel finishing, production tooling problems, and a forum with panel speakers.

Technical speakers were Robert McKee, LeBlond Machine Tool Co., Cincinnati; J. E. Hawkins, Pines Engineering Co., Aurora, Ill.; E. D. Hinkel, Jr., The Carpenter Steel Co., Reading, Pa.; Albert L. Ball, Bay State Abrasive Products Co., Westboro, Mass.; and L. Remsen Skidmore, Jr., True Trace Corp., El Monte, Calif.

Dr. J. Harold Lampe, dean of engineering at the university, welcomed the conferees. Other highlights of the meeting included a report on Carolina industrial progress by George P. Geoghegan, vice president of the Wachovia Bank and Trust Co.; an exhibit area featuring three score displays and demonstrations of the latest equipment and methods; and a library display of books and papers on tool and manufacturing engineering. A luncheon especially for students attracted young men from three campuses, North Carolina State, Duke and Gaston Tech.

More than 60 industrial and educational displays blossomed on the North Carolina State College campus during the ASTME conference. Shown here in the exhibit area are (left to right) James Dorsett, student; Charles Bullin, tool engineer for Western Electric; and machinery company exhibitors George A. Marshall and son George, Jr.

chapter news and views

President Wayne Ewing presents the charter of the Society's newest senior chapter—Southern Minnesota—to Chairman Lester Gouak during ceremonies at Rochester.

Industry and Education Represented on TV Panel

GRANITE STATE—A televised panel discussion featuring representatives from industry and education was the main event of Chapter 86's November meeting. This same meeting also proved an appropriate time for the awarding of the chapter's annual scholarship to a worthy engineering student. The whole affair was staged on the campus of the University of New Hampshire.

The panel members consisted of Jere Chase, director of university development at U.N.H., who was the moderator; Paul L. Deschenes of General Electric Co., Wallace Whitney, personnel director at Miniature Precision Bearing Co., Keene, N. H.; and representing THE TOOL ENGINEER magazine, Senior Associate Editor Theodore W. Black. Sparking the four-man parley was Black's theme of "Self Development in Tool Engineering."

Following the discussion, Leon A. Bowie, a senior in mechanical engineering at the University of New Hampshire was presented with the Granite State Chapter's scholarship. Delivering it to him was Dr. Robert W. Faiman, dean of U.N.H.'s college of technology.

—R S. Downing

Chapter 162 Chartered At Rochester, Minn., With 111 Members

SOUTHERN MINNESOTA – National President Wayne Ewing presented the Society's 162nd charter to Southern Minnesota chapter at a meeting Dec. 3 in Rochester, Minn.

Officers of the newly formed chapter are: Lester Gouak, chairman; Don Knoblauch, first vice chairman; Ed Tervo, second vice chairman; Dana Rogers, secretary; and Bill Freytag, treasurer. The new group was launched with 111 charter members; 130 members and guests attended the chartering.

—Roy J. Jolly

Twin Cities Presents Four Scholarships

TWIN CITIES—For the sixth consecutive year, Chapter 11 has recognized educational institutions and has encouraged students to follow a tool-engineering career through the presentation of scholarships. Four $100 stipends were presented to outstanding students from three Minnesota vocational and technical schools and to one student from the University of Minnesota.

Recipients were Don Baker, Lyle Hurd, LaVerne Johnson and Ruben Mytty. Baker is a fourth-year student in the School of Mechanical Engineering at the University of Minnesota and is doing research on the use of epoxy in drawing dies. *—Edward Gillaspy*

ATLANTA—The patent issued to Eli Whitney for his cotton gin was one of those illustrated by Walter M. Rodgers (left), patent attorney, at the November meeting. Aiding Rodgers in his presentation, which covered patents, patent laws and free enterprise, is Program Chairman Alfred Conrad. *—Gene Cole*

Members Forego Party For Scholarship Fund

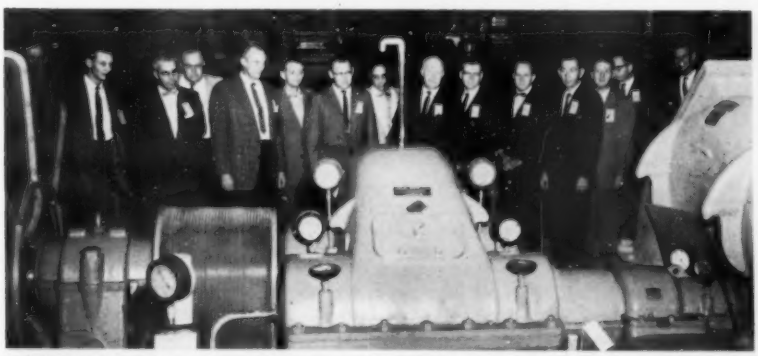
FORT WAYNE—A worthwhile purpose came into fruition with the establishment of a scholarship and education fund by Chapter 56. The fund, which will be controlled by two committees—administrative and financial—got off to a good start with $300, which was realized by omitting the Christmas party, all members agreeing that projects of worthwhile purpose demand work and sacrifice. *—John F. McComb*

52 Percent Attendance Reported by Chapter 158

BRADFORD-OLEAN–ASTE Chapter 158 has reason to look back upon its first year with pride in its achievements, having had an increase of 20 percent in membership. Their meeting attendance has averaged 52 percent of the membership and 240 guests have shared in their programs. *—C. H. Miller*

Televised in the studies of the University of New Hampshire, this panel discussion was the highlight of the Granite State chapter's Industry and Education night. Taking part in the discussion were (left to right) Jere Chase of the university, TOOL ENGINEER Senior Associate Editor Ted Black, Paul Deschenes of GE, and Wallace Whitney of Miniature Precision Bearing Co.

Harold Guellow (right) of the San Fernando Valley chapter presents the second edition of the *Tool Engineers Handbook* to Richard Johnson, who received the book for Joseph Thomson. Other recipients of the handbook were Paul Jones and James A. Broadston. All three, Thomson, Jones and Broadston, are handbook authors.



NASHVILLE—Seventy-two members of Chapter 43 visited the U.S. Air Force's Arnold Engineering Development Center in October. A portion of the group is shown here examining the compressor system for the engine testing facility. The compressor system was used by the Germans during World War II. The group traveled 70 miles for the tour of the air base. *—Harry O. Collins*

Four Speakers, Handbook Presentations Highlight San Fernando Meeting

SAN FERNANDO VALLEY—Representatives of four area plants gave brief but informative discussions of unique processes they have developed in their firms recently. This occurred at the Nov. 4 meeting of Chapter 99 with 114 members and guests present.

The first speaker was A. J. Trimble of Marquardt Aircraft, who informed his audience of a spin-forging process they are using for their massive Hufford unit. Next came Samuel Larner of Radioplane who discussed that company's application of plastics as a supplement to the more conventional tooling. H. Stanley Baird, the representative from Rocketdyne, explained in detail the process of injector drilling, a method of producing holes in missile fuel injector heads. Shot-pin tool and the recent developments being made in this area were described by Jack Early of Bendix Aviation.

The highlight of this November meeting was the recognition of three authors from the area who contributed to the second edition of the *Tool Engineers Handbook*. They were Paul Jones, assistant to the vice president of Radioplane; James A. Broadston, director of service division of Rocketdyne; and, representing Joseph Thomson, owner of Kish Resin Western Sales Co., Richard Johnson. Harold Guellow, chairman of the chapter Technical Publications Committee and treasurer, awarded the three men with copies of the new handbook. *—John R. Bethune*

Meeting Draws 180 Of Chapter's 380

WINDSOR—The regular monthly meeting of Chapter 55 attracted 180 members out of the chapter's total of 380. The November session was on optical gaging and the speaker was J. Stolp, Eastman Kodak. *—Frank Shaw*

Oakland County

Three hundred persons, half of which were high school students from the surrounding area, heard C. G. Schelly, director of the educational department of The DoAll Co., lecture on "The Cutting Edge." Cutting edges of bone, stone, bronze, steel, carbide and ceramics were chronologically displayed on a sectioned panel in his lecture.

Ralph Gooch, chairman of the chapter education committee, spoke on "ASTME and Education," and Chapter Chairman Emerson Brown outlined the aims and progress of ASTME.

chapter news index

Engineer Who Helped Design Battleship Maine Dies at 91

MINNEAPOLIS—Walter G. Holmes, an engineer who helped in the design of the battleship Maine, died recently at Minneapolis. He was 91 years old and a charter member of the ASTME. Burial was at Milton, Mass., his birthplace.

Holmes retired from the Minneapolis-Honeywell Regulator Co. at age 85. He had practiced his profession some 65 years, 43 of them in Minneapolis.

In 1892, following his graduation from Massachusetts Institute of Technology, he designed ventilating machinery for the Maine, the sinking of which precipitated the Spanish-American War.

He is survived by four sons and a daughter. *—Ed Gillaspy*

Elmira

The early attempts at diamond making, the success up to the present day and the future outlook for man-made diamonds were discussed before 42 members at the November meeting by James T. Elovich, manager of diamond sales, General Electric Co.; John A. Mueller, methods and time study engineer for Fedders Mfg. Co.; and John W. Ripple, sales and application, The Carborundum Co.

Educational Films Featured at Dayton Chapter Meeting

DAYTON—Two films and a handbook presentation highlighted the activities of the October meeting of Chapter 18. The films were "One Hoe for Kalabo" and "Manufacture and Measurement of Servo Mechanisms." The handbook went to Howard Cary of Hobart Brothers Co., Troy, Ohio, for his contributions to the welding section of the *Tool Engineers Handbook*. Chapter Chairman Andrew Bailey made the presentation.

The first film dealt with the evolution of machining and automation and was narrated by J. Linn Cochran of The C. H. Gosiger Machinery Co. It contrasted the methods used in different parts of the world for turning out metal products. In order to produce a simple hoe in Kalabo, Africa, for instance, the native must dig bog iron ore and smelt it in a tiny furnace air-blasted with goat skin bellows. The process takes a whole day.

When the scene shifted to the United States, quite a difference was noted in the production methods. A description of machine tools was given, along with the importance played in quantity production by part interchangeability. Machine tools and gages, cutting, drilling, forming, grinding, turning, shaping, and measuring were all featured in the film.

The second film on servo mechanisms was put on by the Sheffield Corp. Ben Widemeyer of that firm discussed the subject before and after the showing.

—Ralph E. Frederick

WINDSOR—Shown touring the Essex College engineering labs of Assumption University in Windsor during Chapter 55's father and son meeting recently are (left to right) F. D. Rail, second vice chairman; Prof. W. G. Colborne of the college; James Challoner, Jr., and his father, who is membership committee chairman of Windsor chapter. Colborne talked to the assembly of fathers and sons on career opportunities in the various engineering branches. *—Frank Shaw*

CANTON TECH—The chairmen of two ASTME groups, Francis Verrillo of Syracuse Chapter 19 and James Alfieri of Student Chapter 13, seem to agree that their joint meeting and plant tour of Lipe-Rollway Corp. last November was a real success. Thirty-four members traveled 135 miles to attend the affair. *—Thomas Kennedy*

Editor Discusses Trade with Russia

ROCHESTER—At the Dec. 7 meeting, with 60 members present, George Sullivan, editor of the Iron Age magazine, raised the thought-provoking question, "Should we trade with the Russians?" The subject of his talk was "Let's Win the Economic Cold War," in which he outlined three basic purposes Russian leaders have in carrying on foreign trade: (1) to plug holes in their domestic economy which they are otherwise unable to plug; (2) to develop trade channels through which a limited number of a particular item can be purchased as models for Russian technicians to copy; and (3) a means to promote economic warfare.

Sullivan, who climaxed his talk with pictures taken while on a three-week tour of the Russian steel industry, claimed that the sooner this country recognizes what they have and what they are after, the easier it will be to meet their threat. Increased trade will probably not improve the standard of living in Russia, he said, but it will surely aid the Kremlin's plans for world conquest. *—O. E. Hosford*

Twin States

"Cerrotechnics" was the subject of a talk given to 50 members of Chapter 40 at the Dec. 9 Past Chairmen's Night by O. J. Seeds, manager, Cerro de Pasco Sales Corp. Seeds covered problems in anchoring or fastening in jig or fixture design, workholding of irregularly shaped parts, glass lenses, carbide tips, and coring of intricate internal shapes in electric-formed or laminated plaster parts. Typical specimens of work done with Cerro alloys were exhibited.

U. S. Manufacturing Research Lacking, Educator Warns

ANN ARBOR AREA—Recently returned from his assignment as an exchange professor at a West German university, L. V. Colwell, professor of mechanical engineering at the University of Michigan, addressed members and guests at the November meeting. Guests at this gathering were industrial arts instructors and students from 11 area high schools.

Colwell, in his talk, indicated that American machining and processing research is falling far behind that of Western Europe. In one part of Germany, Aachen, Colwell estimated that as much research is being done along these lines as in the whole of the United States. And there are other European research facilities doing just as much work as Aachen.

The educator warned that the United States has much work to do if it intends to meet the challenge of European manufacturing engineering. He said that because foreign machine tool builders are able to deliver more machine for the money due to their economic position and their advanced research, American-built machine tools are practically disappearing from the continent. Using the world's largest planer type miller which was recently completed in Düsseldorf as an example, Colwell said the machine, with a 180-ft bed is guaranteed by the builder to hold size and location of the work to within 0.0005 inch anywhere in its travels. It was built at one-half the cost of the lowest U.S. builder's bid, and it took only nine months from the start of design to delivery.

F. R. Boston, the Ann Arbor chapter's second vice chairman, addressed the group next. He discussed a point that is often taken for granted by members of ASTME—the opportunity to discuss "tough jobs" with fellow members at the monthly meetings. Boston called this a Society dividend which allows the member to contribute an idea, pick up a new "wrinkle" and lessen the chance of becoming caught in the groove of his own area of operation.

The chapter officer was also given the pleasant duty of presenting his father, Prof. O. W. Boston, now retired from the faculty of the University of Michigan, with a copy of the *Tool Engineers Handbook*. This was done in recognition of his services as a member of the materials review board of the second edition of the handbook. Boston was also chairman of the manuscript review committee for the handbook's first edition. —*Frederick L. Fitts*

HARTFORD—The third in the Society's 1959-60 series of Creative Manufacturing seminars, cosponsored by the National Education Committee and participating chapters, drew a record 170 registrants when it was staged at Hartford. Credit for the success could be shared by the subject matter of the seminar—numerical control—and the hard work that went into its preparation and presentation. Among the hard workers were (left to right) A. Douglas Proctor, Henry E. Kuryla, Chairman Paul F. Pick, Howard A. Wheeler, Ernest F. Osterling and Ralph Winspear, all of the host chapter.

NORTH TEXAS—A national director and four national committeemen showed up at the November meeting of Chapter 51, at which emphasis was put on Society technical publications, including the new *Tool Engineers Handbook*. Viewing an impressive display—and, incidentally, making an impressive line-up for their home chapter—are (left to right) Bob Ellis, technical publications chairman of the chapter; A. E. Unruh, National Membership chairman; Director Irving H. Buck; F. Paul Simpson, vice chairman of the National Program Committee; and F. L. Edmondson of the National Technical Publications Committee. —*M. G. Lawson*

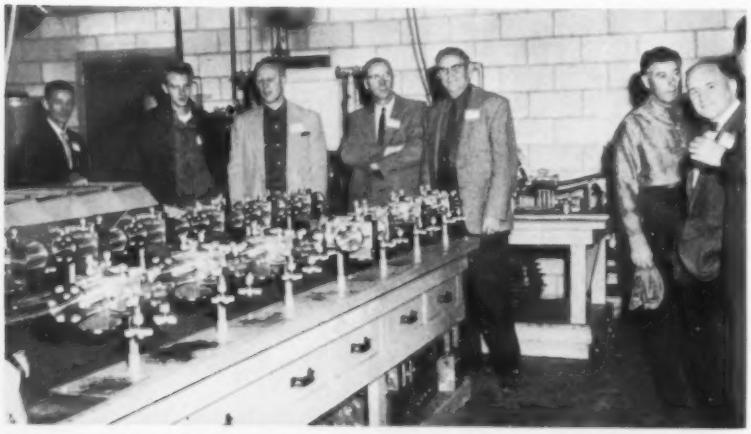
Mid-Pennsylvania

Chapter 161 wound up the year—its first—with a technical meeting on "Residual Stresses in Metals." Speaker was F. (Cliff) Wagner, manager of the metallurgy department, Curtiss-Wright Corp., who discussed the methods of determining such stresses, the effects on fabrication and on service behavior of metals. This was the third technical meeting since the chapter was chartered on Sept. 28, 1959; the other sessions covered plastics for tooling and carbide dies.

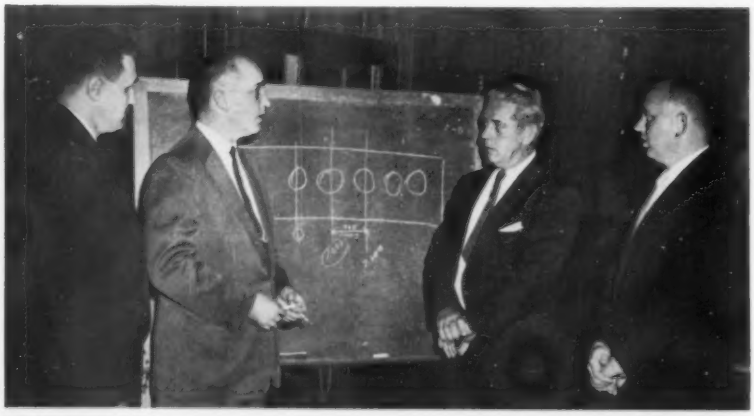
Syracuse

Ninety-six members of Chapter 19 and some of their bosses turned out for the December meeting. The gathering's main attraction was a talk by Jack Kleinoder, president of Vidmar, Inc., a division of Volkert Stampings, Inc., Williamsport, Pa. This company engages in the production of tool storage cabinets. Kleinoder, a member of the board of trustees of the National Tool and Die Manufacturers Association, discussed the apprentice training of tool and diemakers in the United States.

HAMILTON DISTRICT—These nine past chairmen showed up for the program in their honor on Dec. 11, at which Robert D. Roach of Bell Aircraft's Space Flight Div. in Buffalo described the firing and cooling systems of existing rockets. Left to right, front row, are G. Churchill, W. Dawson, W. Shaw, H. Ward; back row, J. Yorick, C. Bulmer, R. Fechnay, F. Johnston and J. Snyder. *—George Bryant*



OKLAHOMA CITY—Kimray Inc., manufacturers of automatic oil field control equipment, was the scene of Chapter 125's December plant tour. A few of the members and guests are pictured in that section of the plant where one of the firm's many products, glycol pumps, are assembled. *—Lee Roy Chapman*



EVANSVILLE—The director of the engineering service lab at American Machine & Foundry Co., Jay H. Bergen (second from left), elaborates on one of the features of his talk on "Simplified Drafting" for some officers of Chapter 73. With Bergen are (left to right) John Schaus, first vice chairman; Charles Hinman, chairman; and Louis Luker, program chairman. *—Earl R. Crowe*

Canada's Northland Familiar to Russia, Engineers Warned

OTTAWA VALLEY—Dr. W. E. van Steenburgh, director general of Scientific Services, Canadian Department of Mines and Technical Surveys, said at a Chapter 136 meeting that Russians may know more about our northland than we do ourselves. Published literature in the scientific field would indicate this, he warned, adding that recent governmental surveys showed that much of the Russian information is correct.

Answering a question from among the audience of 74 members and guests, Dr. van Steenburgh stated that it would be feasible from an engineering viewpoint to block the Bering Strait as suggested by the Soviets. However, he doubted that international agreement could ever be reached for such a procedure because of the climatic consequences in Great Britain and northern Europe.

Program Chairman S. J. Hayes reported that the January meeting was to be on "Chemical Materials for Tool Engineers," by A. G. Mitchell and F. J. Quail of the Canadian General Electric Co. *—S. J. Hayes*

Paper Products Firm Toured by Chapter 11

TWIN CITIES—A tour through the Waldorf Paper Products Co. comprised the November activities of Chapter 11. The plant covers approximately ten square blocks in the Midway district of St. Paul, Minn.

The Waldorf plant uses eight and a half million pounds of steam per day, and when the boilers are operating on gas, they consume 275,000 cubic feet of gas in that same period. Enough electricity is generated to light 130 homes for a month.

In turning out their product, the firm uses 200 cords of aspen per day on a single paper machine. Other machines use pulp from Missoula, Mont., and wastepaper. In one day about 700 tons of paper are produced. One particular machine, producing 250 tons in a day with a 132-inch trim, runs off 775 feet of paper per minute. Waldorf's paper production for one day would stretch from St. Paul to International Falls.

The most striking part of the paper company's operations, according to the ASTME members who viewed them, was the savings obtained by good engineering. The fact that the company generates its own electricity in order to obtain its tremendous steam consumption free, constitutes only one of the economical procedures. *—Ed Gillaspy*

SPECIAL EVENTS

ASTME Seminar—"Automation and Your Production Program"	Feb. 4, '60	Sheraton-Cadillac Hotel Detroit, Mich.
On-Campus Conference	Feb. 13, '60	University of Colorado Boulder, Colo.
ASTME Seminar—"Plastic Tooling"	Feb. 24-26, '60	Chase-Park Plaza Hotel St. Louis, Mo.
Second Annual Production Institute	Mar. 21-22, '60	University of Wichita Wichita, Kan.
ASTME 28th Annual Meeting and Engineering Conference	Apr. 21-28, '60	Statler-Hilton and Sheraton-Cadillac Hotels Detroit, Mich.
ASTME Tool Show	Apr. 21-28, '60	Detroit Artillery Armory Detroit, Mich.

Guidance Systems Seen On Milwaukee Tour

MILWAUKEE—A look behind the scenes of missile making was provided the members of the Milwaukee chapter when they were guided through the Oak Creek facility of the A-C Spark Plug Div. of General Motors. Seen under construction were the guidance systems which are the electronic brains that make such places as Cape Canaveral possible.

At an assembly point the members were given a briefing on some of the problems of manufacturing a complex mechanism to close tolerances using standard machine tools. Chief design engineer, Dr. James Bell, introduced the group to the basic concept of "inertial guidance."

Because of the close tolerances involved, temperature and humidity are critical factors in the machining areas of the plant. Tolerances were being held to a 0.0002 inch and to a 0.0005 TIR on many items. Tolerances such as these are common in production on specially designed machines, but this being semiproduction of items which are being developed and constantly improved, the tolerances mentioned must be and are being held on standard equipment such as those found in the toolroom.

Most impressive to those taking the tour were the assembly areas, where temperature and humidity are highly controlled and all personnel are clothed in white nylon to eliminate all dust and dirt. The tourists were informed that all personnel entering the area must pass through a 30-mile-per-hour wind tunnel before entering the laboratories and must wear rubber or plastic finger tips during the assembly process. One speck of dirt or a fingerprint can ruin an otherwise perfect assembly.

—E. M. Murphy

Guest speaker, Father Daniel Linehan, S.J., director of the Weston Observatory and member of three expeditions to Antarctica, explains the working and living conditions of that continent to Boston chapter members. At his right are seated Nick Juliani, chapter chairman, and Philip Marsilius, ASTME national vice president.

Electrical Machining Is Long Beach Topic

LONG BEACH—Chapter 84 wound up its year of technical meetings with a session on "New Horizons with Electrical Discharge Machining," featuring Tony Rotundo of Allied Pacific Mfg. Co.

Rotundo explained electrical discharge machining as a series of discharges occurring at a rate of 20,000 to millions per second between the electrode and workpiece, electrons piling up on the surface of the electrode until the stress becomes so high that they crash through the surface barriers and bombard the workpiece at the speed of light. This results in a net positive charge which is movable and attracted toward the negative electrode. At this point the power is shut off and the positive charged atoms are washed out of the gap by coolant, and as the discharges occur, the tool is advanced so that the removal of metal is continuous and the cavity formed is a duplicate of the tool.

—Paul J. Bodnar

Antarctic Explorer, National Officer Heard at Boston

BOSTON—Philip Marsilius, ASTME national vice president, and Father Daniel Linehan, S.J., of Weston College were the guest speakers at the Boston chapter's annual executive night in November.

Marsilius commenced the evening's program with a description of what a new expansion program will do for ASTME's present educational and technical activities. He also discussed the addition to the Society's name.

Father Linehan, director of the Weston Observatory and renowned seismologist, followed Marsilius. His talk dealt with his participation in three United States expeditions to the Antarctic as part of a Navy team of geophysical engineers. Father Linehan's work consisted primarily of determining the thickness of a number of ice packs and finding the appropriate terrain for a permanent campsite. Measuring the earth's magnetic field was another part of his assignment. At one point he was involved in a project to determine the feasibility of constructing a year-round air base in the frozen wastes of the South Pole.

The problems faced by the scientists because of the Pole's weather conditions and lack of animal and vegetable life were depicted by the speaker in a series of color slides.

—Les Horne

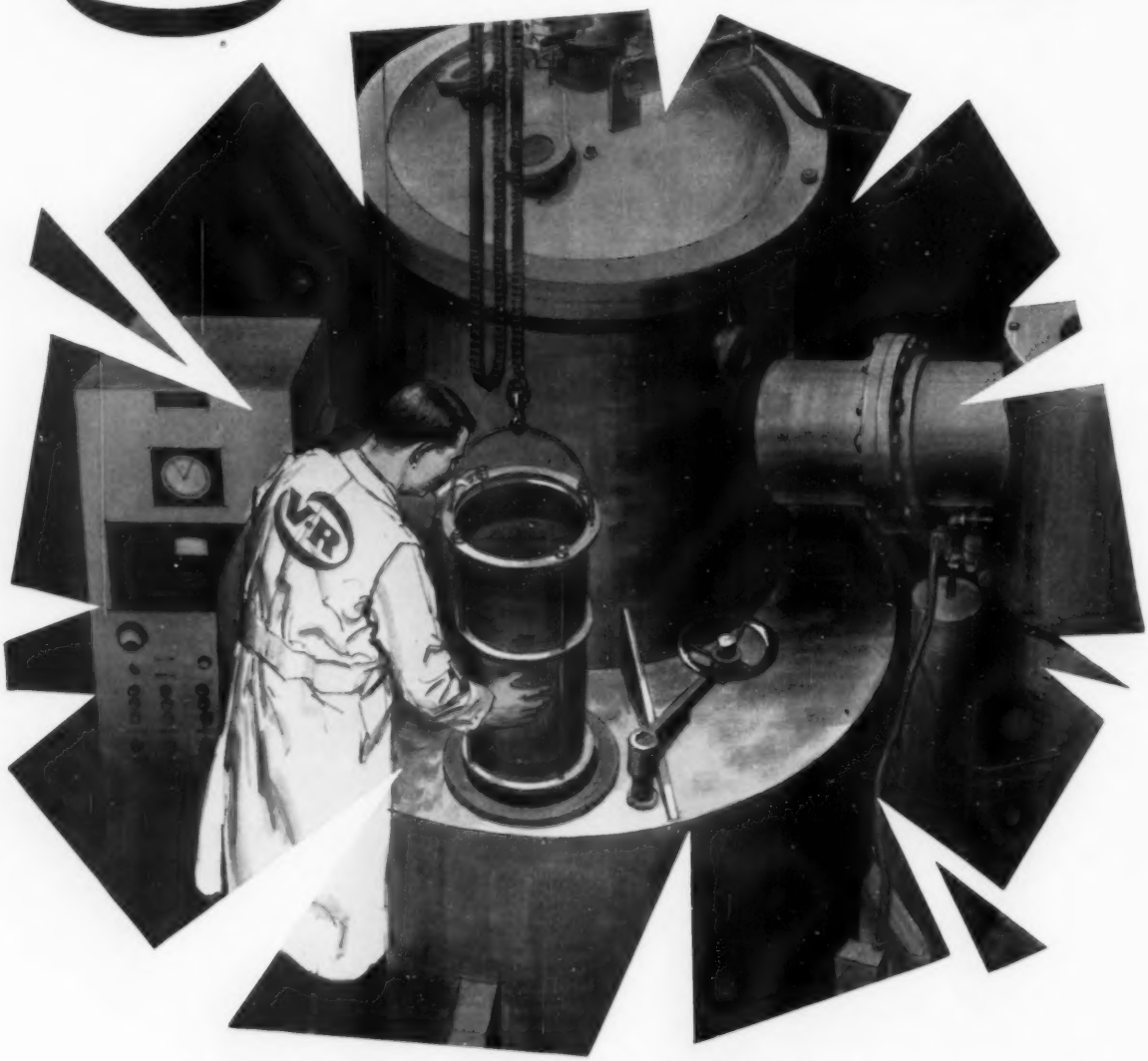
Scholarship Goes To Toledo Student

TOLEDO—Robert Eugene Piniazkiewicz of the University of Toledo has received a $700 scholarship toward his studies in mechanical and industrial engineering this year. As first alternate runner-up, he was next in line for an ASTME International Education Award when Robert Zimmer of the University of Illinois, one of the original 1959 winners, withdrew from school.

Now in his senior year at Toledo, Piniazkiewicz has earned 50 percent of his tuition during the past three years and still retained the highest scholastic average in the industrial engineering department.

V-R

CREATING THE METALS THAT SHAPE THE FUTURE



V-R vacuum sintering makes better carbide

Vacuum sintered steel cutting carbide grades are more versatile because precise control during vacuum sintering removes trace impurities . . . increasing the strength of V-R carbides and their ability to withstand cutting conditions which generate extreme heat. Vacuum sintering is one of the many reasons for the superior performance of V-R's new carbide grades for machining all types of steel and the new superalloys. At V-R, the finest in modern equipment is effectively combined with the metallurgical knowledge gained through 30 years of carbide research and manufacturing experience . . . experience that means better carbide for every use.

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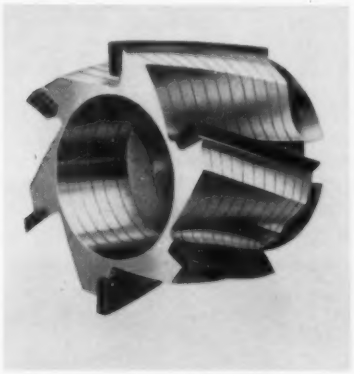
Progress in Production

WAFER TYPE CUTTERS HAVE LONGER LIFE

A new approach to cutting tool manufacture which utilizes wafer type construction of cutters and reamers is making it possible for industry to effect significant savings in the cost of perishable tooling. Additional savings are realized in lower replacement costs and improved tool performance.



Milling cutter fabricated by wafer construction. Brazed assembly is ground conventionally.

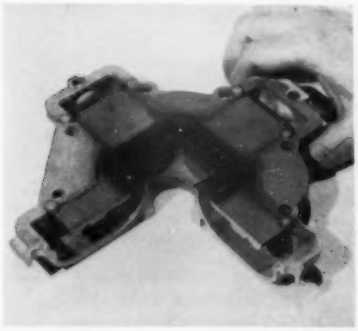
Metal wafers used in construction of the cutters are preformed in large quantities by production stamping. With major geometrical configurations incorporated into their design, wafers are assembled on arbors of various sizes corresponding to lengths and styles of tools already in use. Either high-speed or carbide cutting tips are placed in appropriate cutouts and the entire assembly is brazed into a solid mass.

Increased density of wafer type tools acts as a vibration dampener tending to eliminate chatter. This factor improves tool life because chatter is the primary cause of fracture of ultrahard cutting tips. Further tool life improvements result from the dissipation of heat at cutting edges. Wafer-type cutters are manufactured by Spiral Carbide Tool Co. of Detroit.

ADHESIVES CUT ASSEMBLY COSTS

Castings of complicated configuration are easily and economically produced by assembling simple cast sections with adhesive bonding agents. One manufacturer has reduced casting rejection rates from as high of 25 percent to zero by use of this assembly technique. In this application three separate die castings are assembled by adhesive bonding to form one complicated pump assembly. The adhesive used is a product of Adhesives, Coatings and Sealers Div. of Minnesota Mining and Mfg. Co. Epoxy resin is used as a base.

Previously, the pump part was cast in one piece by the sand mold process. Because of the complex interior design of the casting, blow holes often occurred causing the high rejection rate. Hence, the decision to use component castings fastened together. Adhesive bonding of the castings was selected as the method of assembly to eliminate machining necessary for mechanical fasteners. An additional advantage of adhesives is that



Cutaway section of casting showing three adhesively bonded sections.

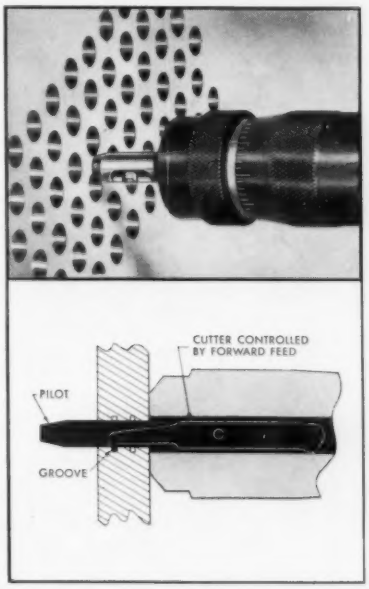
sealing and gasketing operations can be dispensed with.

Adhesive bonding does not require the high temperatures necessary for welding or brazing operations which tend to distort castings. It also permits use of a greater range of materials and the utilization of unskilled labor in assembly operations.

GROOVING TOOL FOR HIGH-PRESSURE TUBES

Increasing pressures in high heat exchangers have dictated new ways of joining heat exchanger tubing to flanges, housings and other solid structures. Latest technique is to employ grooved locating holes into which the heat exchanger tubes can be swaged.

Machining a large number of grooved holes in heat exchanger tube sheets would normally require complex tooling



Adjustable arbor, pilot and grooving tool (above) and cross section showing tool and workpiece (below).

operating at relatively low production rate. The Ross Heat Exchanger Co. of Buffalo now employs a spring-loaded cutting tool, called the "Bak-Sink," a development of Cogsdill Tool Products, Inc., Oak Park, Mich.

In operation the grooving tool is mounted in a spindle of a programmed drilling machine which positions the tool in front of the hole to be machined. As the tool enters the hole during forward feed, the cutting blade remains inside a pilot arbor. When a ball bearing rotary collar on the tool seats against the work, further forward feed forces the cutter out of the pilot arbor. On the reverse stroke, the blade re-enters the arbor so that it clears the work before removal of the arbor.

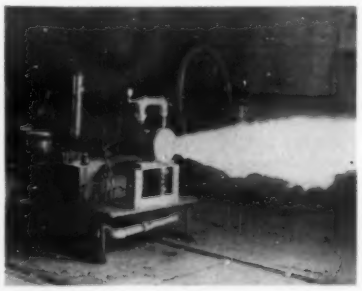
Grooving-tool speeds approximate reaming speeds for the same material and hole size. Feeds are not critical

since an over-travel safety within the tool prevents increased depth of cut under excessive feed. Blades can be altered to vary cutting clearance for different materials.

Blades and pilots can be easily changed without special tools. In this way the same basic tool can cut a number of different grooves over a wide diameter range.

BURNER REDUCES FURNACE CYCLE TIME

Installation of a new pulsating type burner on a reverberatory furnace at Anaconda Company's Great Falls Plant has resulted in a 12-percent cut in fuel consumption and a reduction of furnace cycle time to 24 hours. These dramatic results are attributed to the design of the burner which enables it to reach temperatures as high as 3450 F using #6 oil as fuel. With use of 1000Btu/cu ft natural gas as fuel, it is possible to attain temperatures above 3300 F. The higher temperatures attained by the Burner result from the method in which fuel and air are mixed. Small steady explosions create turbulence which results in increased combustion efficiency.



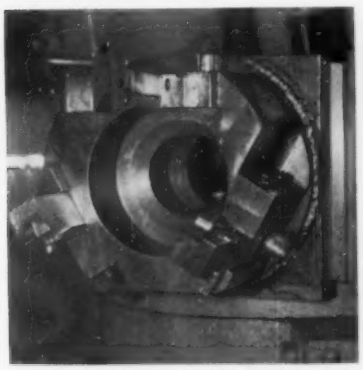
Pulsating burner in operation. Explosive combustion within burner creates high temperature and flame velocity.

Resulting velocity near the center line is approximately 600 fps, nearly 12 times that of conventional burners. Release rate of the burner is about 5,500,000 Btu/cu ft, a rate more than five times as great as that of the average burner used in steel mill applications. Operating continuously through a 6 day test period at Anaconda, the burners, manufactured by E. W. Bliss Co., showed no evidence of deterioration or loss of efficiency.

INSERT TOOLING INCREASES LATHE EFFICIENCY

Until recently the machining of 10¾-in. diam forged steel gear blanks in an

Indiana plant took six hours during which 40 pounds of metal were removed in rough and finish turning of inside and outside diameters. When production requirements increased, the use of single-point tooling became too expensive and inefficient. To improve machining time two catheads, each holding



Cathead for turning and boring gear blanks. Gear material is SAE 4140 H forged steel.

three Kendex throw-away insert tools, were designed.

The two heads are used for rough machining the inside diameter of the gear. Tools on the first cathead remove the bulk of the stock, each insert taking a full width of cut (¾ in.) at the bottom of the bore. Tools on the second cathead complete the roughing cut on the hub and step turn the main bore.

With this tooling 17 cuts are taken with each head before the inserts are indexed to new cutting edges. With three indexable cutting edges per insert, 52 cuts or 26 gears are completely rough machined for each set of inserts. Total time per piece was reduced from six hours to an average of 54.8 minutes.

CAMERA AUTOMATES BLUEPRINT PRODUCTION

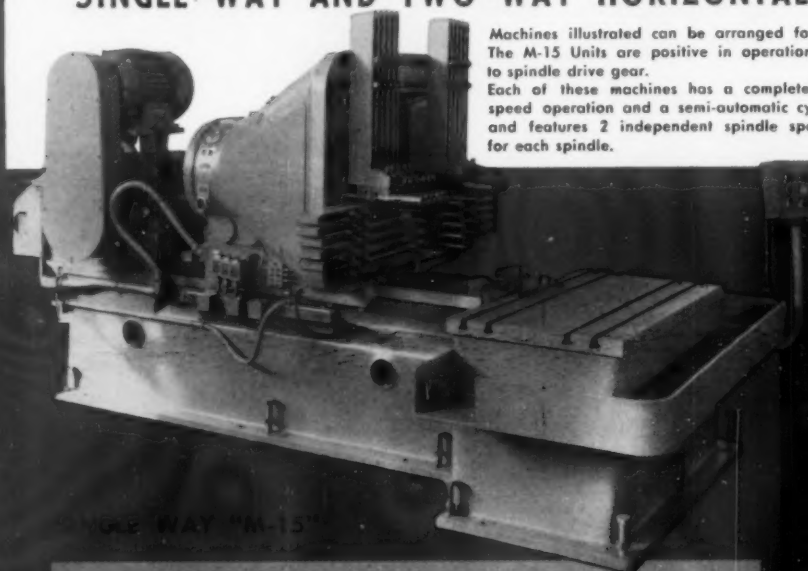
A photoflow camera which produces blueprints up to 700 ft long has been placed in the Reproduction Section of the Engineering Dept. of AC Spark Plug, a General Motors Div. Before the flow camera was purchased, blueprint copies were obtained by running the original drawing through a blueprint machine once for each copy desired. Distribution of most prints is over 50 copies.

Though smaller, the prints hold their legibility and are easily visible to the naked eye without the benefit of a reading instrument. Where small detail is important, however, the drawings must be enlarged by draftsmen and made compatible to miniaturization.

BAUSH MECHANICAL LEADSCREW FEED "M-15"

SINGLE-WAY AND TWO-WAY HORIZONTAL MACHINES

Machines illustrated can be arranged for both drilling and tapping. The M-15 Units are positive in operation as feed is geared directly to spindle drive gear.
Each of these machines has a completely automatic cycle for high-speed operation and a semi-automatic cycle for low-speed production and features 2 independent spindle speeds plus a neutral position for each spindle.



SINGLE WAY "M-15"

The "M-15" Units used on both these machines are extremely versatile — positive in action — trouble free — fast operating and can be mounted vertically, horizontally, or at any angle needed for specific machine designs. These Units are also available in 10 H.P. to 40 H.P. capacity to meet requirements.
When head goes from rapid traverse to feed stroke, an electric brake holds leadscrew and shuts off traverse motor — saving wear and tear. "M-15" Units are the answer to high production at lowest cost.

MECHANICAL LEADSCREW FEED

is an exclusive with BAUSH.

Many commendable reports have been received from users as to their numerous advantages:

No hydraulic fluid

No fluid leaks or fluctuation in feed

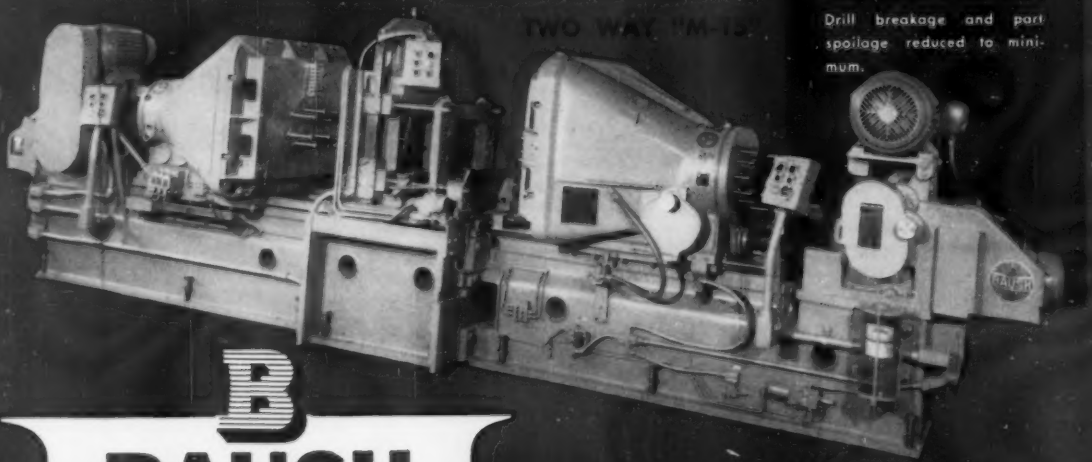
Indirect maintenance costs reduced

Your own mechanic can maintain unit

Positive feed thru ball-screw

Break-thru surge eliminated

Drill breakage and part spoilage reduced to minimum.



TWO WAY "M-15"

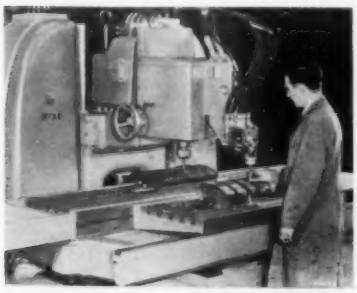
Write for literature on BAUSH Mechanical Leadscrew Machines — or better yet, send us your production problems — let us help you.

BAUSH
MACHINE TOOL CO.
SPRINGFIELD 7, MASSACHUSETTS

TOOLS

Bed-Type Mill

Characterized by extreme flexibility, this bed-type mill will perform as a production profiling machine, a duplicator in three dimensions and as a conventional milling machine. It should be useful to plastic mold shops and shops engaged in making coining, drop-forging and die-casting dies. Three types of control are available: hydraulic, electrohydraulic (automatic) tracer control or numerical control.



Spindle speeds vary with horsepower —215 to 3000 rpm for a 15-hp model and 37 to 3000 rpm for a 40-hp model. A master table (illustrated) is furnished as standard equipment when the machine is ordered with tracing systems. The hydraulic system includes a 188-gal divided reservoir hydraulic tank and electric motor that powers the hydraulic spindle, the tracer head and all hydraulic speeds.

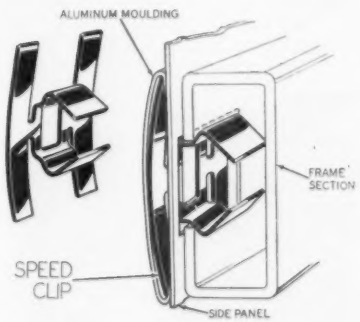
Condensed specifications are: table workings surface, 24 x 84 in.; longitudinal feed, 48 in.; cross feed, 16 in.; vertical ram movement, 24 in.; transverse ram movement, 16 in.; maximum cross range (saddle and ram), 32 in.; distance from cutter spindle to table top, 6½-in. min. to 38 in. max; spindle taper, No. 52 NS; size, 120 in. high, 182 in. wide, 121 in. deep.

The George Gorton Machine Co., Racine, Wis. **Circle 350**

Spring Steel Clips

Designed to accommodate molding which is approximately three in. wide and runs the entire length of truck or coach bodies, spring steel speed clips are spaced about a foot apart and hold the molding snugly against the side panels.

Assembly of the molding requires no special tools or skills. The clips are inserted at either end and moved along the inside of the molding to desired positions. The arch in the back of the clip holds it in place. The molding is snapped on the side panel. As the legs of the clip pass through the panel hole, they compress then expand on the underside to grip the panel and hold the molding under constant live spring tension without vibration loosening.



The clip can also be used as a retainer for inspection plates, decorative automobile dashboard cut-out covers, extruded aluminum mullion covers, trim on metal furniture and in similar applications.

Tinnerman Products, Cleveland, Ohio. **Circle 351**

USE READER SERVICE CARD ON PAGE 169 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Power Screwdriver

Equipped with an exclusive Micro Clutch that permits depth control in driving screws to predetermined settings within 0.001 in., an additional line of Scruguns is available in four models. The clutch automatically releases pressure when the screw has been driven to a pre-determined depth. With proper clutch adjustment, damage either to the screw or the work is prevented, whether on flush, above-surface or below-surface fastening jobs when normal "lead" and body holes are drilled.

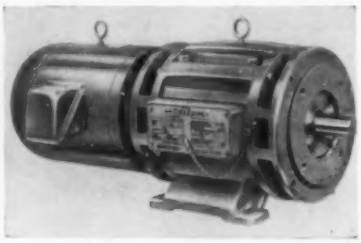
The precise depth-control feature prevents the danger of stripping threads in tapped holes. The tool drives self-tapping screws firm and tight in sheet metal, without distortion. Bit life is increased by removing the strain from bit edges.

The No. 10 Scrugun will handle wood screws up to No. 10 x 2 in., machine screws and nuts up to No. 12, and self-tapping screws up to No. 12. The No. 12 tool will handle wood screws up to No. 12 x 2 in., machine screws and nuts up to ¼-in. diam, self-tapping screws up to ¼-in. diam and lag screws up to ⅜ in x 2 in. The standard speed without load is 800 rpm for the No. 10 and 660 rpm for the No. 12. Both can be supplied with or without a reversing switch.

The Black & Decker Mfg. Co., Towson 4, Md. **Circle 352**

Clutch, Brake Units

An alternate design option now applies to an entire series of modular package clutch-brake units. The option centers about an internal spline drive system, ideal for machine drive applications involving unusually heavy torsional reversals, shock loads, and vibratory conditions.



Cycledynes are used on fast cycling start-stop machine drive and control systems, where applications may involve these abnormal load situations. When a unit is installed between the drive motor and the driven machine it becomes possible to use the motor rotor flywheel action advantageously, rather than fighting it with each start and stop of a stop-start cycle. The motor inertia helps to accelerate the load when the clutch functions, and subsequently, when the brake stops the load, it is unnecessary to decelerate the motor rotor and absorb its high momentum. Forced air cooling is continuous in the unit, whether the load output shaft is running or stationary.

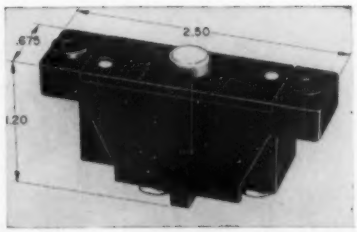
The "building block" modular machine drive units are supplied with the spline drives in a range of five sizes, for power transmission requirements ranging from ½ to 50 hp.

Cycledynamics Inc., 19025 W. Davison Ave., Detroit 23, Mich. **Circle 353**

Two-Circuit Switches

Two-circuit precision switches, designed for use on machine tool limit and control mechanisms, have a median mechanical life which exceeds 10 million operations at full overtravel. Three of the snap-action switches of this 3MN series have a combined stacking width of only 2.03 in.

The step-design, arc-resistant plastic case provides extra space between the integral terminals, reducing the possibility of shorting. One of the mounting holes is elongated to eliminate the need for close tolerance in the center-to-center distance between mounting holes on the equipment.

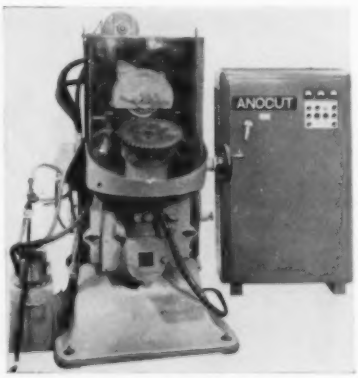


A minimum of 0.080-in. overtravel is provided. Contact arrangement is single-pole two-circuit double-break. The series is listed for 15 amps., 120, 240, 480 or 600 vac.

Mono-Switch Div., Minneapolis-Honeywell Regulator Co., Freeport, Ill. **Circle 354**

Automatic Grinder

The electrolytic grinding process has been applied to an automatic face mill grinder providing a combination which produces savings in diamond wheel costs and cutter life, while improving workpiece finish due to the face radius and reduced grinding run-out on the mill. The process also eliminates carbide insert cracking and checking.



In a completely automatic cycle, the machine grinds the lead angle, corner radius, face radius, dish and soft steel backing of inserted teeth. Tooth shape is controlled by a simple cam arrangement. Machine cycle time on a given tooth averages 29 sec, producing approximately an 8 microinch finish.

Four machine sizes accommodate face mills from 4 to 21-in. diam. The face plate which holds the cutter indexes automatically and can be set for 8 or more teeth.

The machine operates hydraulically and utilizes a 300 amp Anocut electrolytic unit or equivalent. Machine setup time for various cutters takes approximately 5 to 10 minutes.

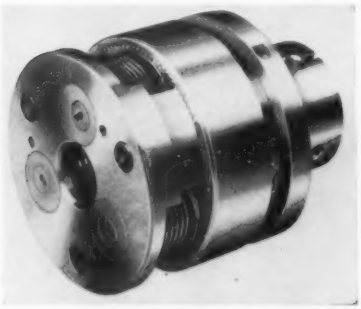
Oliver Instrument Co., Adrian, Mich. **Circle 355**

Thread Rolling Head

No. 3½ series thread rolling heads are manufactured in two styles, stationary and revolving, to cover a UNC and UNF range from ¼ to ⅞ in.

Designed to withstand the wear of continuous high production, the stationary head is adaptable to turret lathes, hand screw machines and automatic screw machines employing a stationary type head. The revolving head is for application to automatic screw machines utilizing a revolving type tool. In addition, they can be applied to threading, drilling and tapping machines.

The heads have replaceable helix angle bushings. By the use of a "mean" angle, one set of standard bushings is sufficient to roll all UNF and UNC threads with the range of the head. When an application necessitates an exact helix angle, the proper bushings can be substituted, eliminating the need for a special head.



Other economical advantages include the fact that the rolls never require regrinding, allowing the heads to operate indefinitely without adjustment after initial size has been established. The thread rolls, which incorporate cage needle bearings for servicing ease, are designed to be reversed and both ends used.

Both of the heads are self-opening in operation and the use of leadscrew, cam or positive feed is not required.

Landis Machine Co., Waynesboro, Pa. **Circle 356**

Two-Position Toggle Clamps

Plunger-type toggle clamps that lock in either an extended or retracted position are designed principally for general purpose use in light assembly work of the electronics, aircraft and allied industries. Both clamps, Model 601 and Model 601-0, have a rated holding pressure of 95 lb.

Model 601 has a tapped hole in the plunger to take a rubber-tipped adjustment spindle and lock nut for extending or shortening its reach. The 601-0 has a ¼-20 thread on the plunger end to allow

easy positioning of various holding devices. Center distances of base mounting holes are ⅝ in. to fit standard aircraft peg-board assembly plates. Height from base to centerline of the plunger is ½ in. Plunger travel on a complete stroke is ⅝ in.

Detroit Stamping Co., 350 Midland Ave., Detroit 3, Mich. **Circle 357**

USE READER SERVICE CARD ON PAGE 169 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Self-Spraying Penetrating Oil

Using a special light oil formulated to quickly free corroded parts, Sprayon No. 203 penetrating oil is packed in self-spraying aerosol cans for pinpoint delivery and quick penetration. It is ideal for lubrication of tight-fitting parts and will not harm painted surfaces.

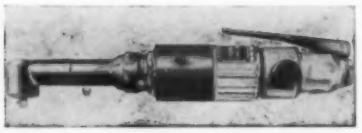
No. 203 penetrating oil, in a 16-oz. container, is part of a line of 47 maintenance and production aids in self-spraying containers. The line includes color code enamels, standard machinery finishes, special lubricants, protective coatings and de-greasers.

Industrial Supply Div., Sprayon Products, Inc., 2075 E. 65th St., Cleveland 3, Ohio. **Circle 358**

Power Wrenches

Heavy-duty right angle wrenches facilitate nutrunning under power in difficult access areas. These non-reversible 90-deg angle wrenches are of the stall type with a ½-in. square drive spindle. Three models are offered, with speeds of 1000, 700, and 500 rpm available from vane-type air motors.

Rated bolt sizes range from $\frac{7}{16}$ to $\frac{9}{16}$

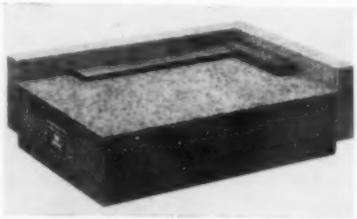


in., with torque outputs from 30 to 63 ft-lb. The largest model, 500 rpm, weighs 9 lb. and is 17⅞ in. long. The two smaller models weigh 8¼ lb. and measure 16 in. long. All three have head diam of 1¾ in. and a height of 2 in.

Buckeye Tools Corp., 5003 Springboro Pike, Dayton 1, Ohio. **Circle 359**

Surface Plates

Precision granite surface plates, designed for rapid three-dimensional checking, speed up operations by providing accurate angles that allow two or three sides of a precision part to be checked simultaneously.

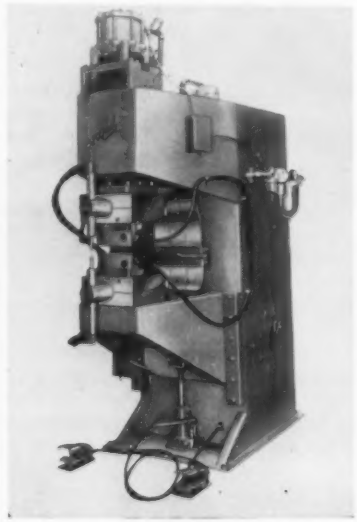


Inside square plates may be produced with one or two vertical sides. All angles formed by the sides and the base are held to an accuracy of 90 deg ± 3 sec. The plates are manufactured of true quartz granite for long life and dimensional stability.

The Herman Stone Co., 1860 N. Gettysburg Ave., Dayton 27, Ohio. **Circle 360**

Combination Welder

Designed for sheet-metal, wrought-iron and wire fabricating work, this combination spot and projection welder, Model ARKN, is available in current capacities from 50 to 200 KVA, attaining



temperatures adequate for welding 16-ga aluminum and 7-ga cold-rolled steel. A two-stage foot switch allows selection of either manual or automatic high-speed operation. Speed is controlled by a weld-timer circuit and an ignition contactor.

Alphil Spot Welder Mfg. Corp., 1058 Pacific St., Brooklyn 16, N. Y. **Circle 361**

Drill Presses

Versatile 15-in. drill presses make up a line which includes 40 models available with high or slow speed, single or multiple spindle, No. 2 Morse taper or ½-in. key chuck spindle and standard or production table. In addition, components of the press may be obtained for making up special purpose equipment.

Primarily a production-line tool for metalworking, the machine is adaptable enough to make it suitable for small commercial shops. Four over-sized, preloaded, lubricated-for-life ball bearings are incorporated in the spindle construction. A heavy-weight head, cast in a single piece, and a large, two-in. diam quill provide rigidity and long life. A multiple-spline "floating drive" means less vibration, smoother operation and more power at the spindle.

Slow and high speed models offer a range of 470 to 4600 rpm with a choice of four speeds in each model. A multi-speed attachment permits wide ranges for such operations as reaming at slow speeds and small hole drilling at high speeds. The drill press is powered by a ⅓ or ½-hp motor. Spindle travel is 4 5/16 in.

The drill presses also offer a new universal hand feed mechanism that combines the best features of pilot wheel and single lever feeds, and a streamlined quick-change belt guard that completely encloses belt and pulleys for safety.

Rockwell Mfg. Co., Walker-Turner Div., 400 N. Lexington Ave, Pittsburgh 8, Pa. **Circle 362**

USE READER SERVICE CARD ON PAGE 169 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Vanadium End Mills

Designed for machining hard abrasive materials, a line of end mills are made of Vanadium high-speed steel. They have higher red-heat hardness and substantially more abrasion resistance than conventional M-2 steel end mills. Prehardened materials, R_C 30-40 and the newer, tough to cut, high-strength, high-heat resistant materials can be successfully machined. The tools differ from a general purpose type in that they have a specially designed cutting face to provide maximum cutting efficiency on materials of this type.

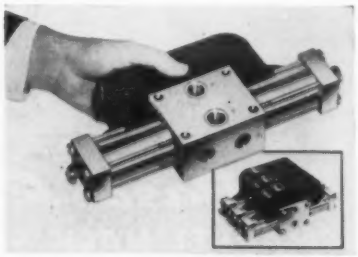
The end mills are standard in 2, 3, 4, and 6 flutes from ⅜ through 2-in. diam. Also available are four flute center cutting, miniature sizes starting at 1/32-in. diam, key-way, and large diam 2 in. and over with Sure-Lock shanks.

The DoAll Co., Des Plaines, Ill. **Circle 363**

TOOLS of today

Four-Way Solenoid Valves

High fluid capacity, high pressure ratings, light weight, and low current consumption are features of a line of four-way a-c solenoid valves. Valve body material is high-strength aluminum alloy, with heat-treated steel spools and sleeves. This construction, with compact design, results in a weight of less than 5 lb per valve, including two solenoids.



The line is available in ⅜-in. pipe size. Other sizes are in preparation. The three standard designs are closed-center, tandem, and two-position. The valves are rated at 3000 psi. Rated pressure may be applied to all ports. The direct-actuated spool requires no back pressure or minimum flow for proper operation. Full-size porting and simplified inner design provides low pressure drop of about 60 psi at 5 gmp.

Cycling rates greater than 60 cpm are entirely practical. Valves are available for 110 or 220 v operation, using the same coils for any frequency, 25 to 60 cps. Power consumption is 25 watts per coil at all voltages.

Waterman Hydraulics Corp., 725 Custer Ave., Evanston, Ill. **Circle 364**

USE READER SERVICE CARD ON PAGE 169 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

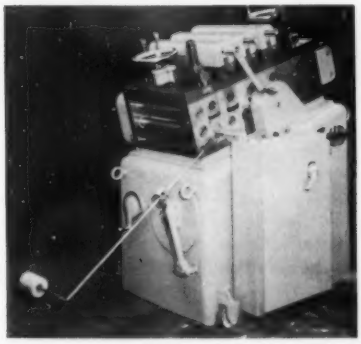
Metal Straightener

Model No. PDS-16H power driven straightener has a capacity for material up to 16 in. in width and up to a maximum of ¼ in. in thickness (cold rolled steel, hot rolled steel, brass, copper, aluminum). The unit is designed for the removal of coil set from material in coil form usually used in conjunction with automatic feeding equipment for advancing the material into punch presses, press brakes or other fabricating equipment. The straightener has a pair of power driven take-in rolls, six straightening rolls (4-in. diam on 6-in.

Use Reader Service Card, CIRCLE 73

Use Reader Service Card, CIRCLE 74

centers, upper 3 individually adjustable. lower 3 power driven), a pair of power driven take-out rolls, and quick release on take-in and take-out rolls. All rolls are hardened and ground, mounted in bronze bearings and driven by means of hardened gears. The machine has

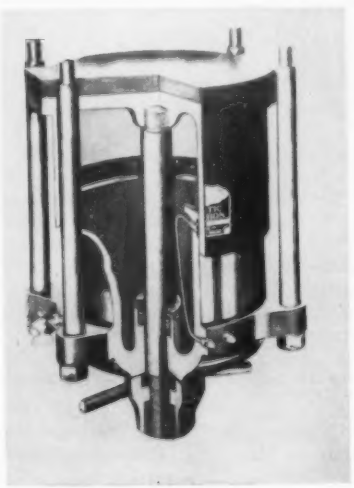


loop control with electric clutch, casters for portability, and a 5-hp variable speed driven unit with outputs from 10 to 50 fpm.

U. S. Tool Co., Inc., Ampere (East Orange), N. J. **Circle 365**

Pneumatic Die Cushion

Provided with a full hardened and ground pin pressure pad and oversize hardened and ground piston stem, this universal unit may be used in either bolster plate or press bed mounting. The unit is available in nine sizes with ring holding pressures from ½ to 20 ton.

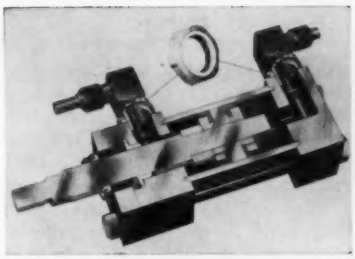


The unit, of steel weldment construction throughout, comes complete with all necessary fittings and can be adapted to practically any power press.

Dayton Rogers Mfg. Co., Minneapolis, Minn. **Circle 367**

Port Seals for Power Cylinders

Protection against overtightening damage is provided by port seals used on standard models of air and hydraulic cylinders, boosters and accumulators. The port seals, which provide perfect sealing and speed positioning, consist of a hexagonal steel threaded nut with a threaded Teflon insert that is impervious to the chemical or corrosive action of all hydraulic fluids, air, steam, water and gases.



To install, the port seal is threaded as far as it will go hand-tight onto fitting or pipe. The fitting is then threaded

into the cylinder port at least three turns, plus any fraction of turn necessary to point the fitting in the desired direction, and the sealed and positioned installation is then completed by tightening down the port seal against the cylinder port shoulder, using only light to medium wrench torque. Use of pipe dope compounds is completely eliminated.

Miller Fluid Power Div., Flick-Reedy Corp., York and Thorndale Roads, Bensenville, Ill. **Circle 368**

USE READER SERVICE CARD ON PAGE 169 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Missing Parts Detector

A multiple feeler assembly stops machines when parts are not ejected on schedule. The unit protects dies from damage-causing overloads. Properly ejected, small parts striking against the multiple feelers of the type 700--U assembly break a magnetic contact and send the required impulse to the missing parts detector control unit. If the impulse is not received by the unit, electronic circuits automatically signal the emergency stop circuit, preventing the machine from striking again. The unejected part cannot cause a die-damaging overload. Gravity plus magnetic pull return the feelers to normal position after each stroke.

Type 700-U was designed for use where parts are too small for the single feeler Type 700-L, or the wider spaced

multiple feeler Type 700-O assemblies. The unit can be used on presses with speeds up to 150 spm.

Wintriss, Inc., 20 Vandam Street, N. Y. 13, N. Y. **Circle 369**

Resistance Heater for Wire

Application of heat to heading operations is easily accomplished with the compact, portable Reslec resistance heating unit. The 5 kva unit is a small, versatile model which will meet low power requirements. The unit completes the range of Reslec heaters, produced in sizes from 5 kva to 1800 kva, with larger units made to order.

Standing 14 x 18 x 34 in. high, the unit will handle 0.050 to 0.213 wire. It offers low cost operation and can be moved quickly and easily from job to job. Only one connection is needed; no air, water or induction coils hamper production.

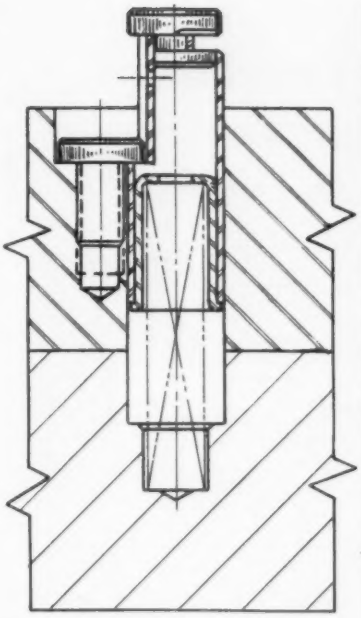
Cost-cutting applications are found in heading and fastener industries, where the unit is used to warm the wire stock

prior to heading operations. Adding controlled heat gives greater plasticity to the wire, thereby increasing tool life and production. Another use of the heater is in wire drawing mills, where annealing and processing can be done at fast rates while the wire is in motion. Eliminated is time-consuming coiling of the wire and its transfer to furnaces, with pickling and other operations following. In some instances, warming the wire just before it goes into a draw has made it possible to eliminate two stages of a three-stage drawing operation. The heaters are also used in silver soldering operations, stretch forming of titanium or other sheet, and in heating metal sheets for a variety of purposes.

The Herscott Corp., 1435 Preston St., Rockford, Ill. **Circle 370**

Stock Lifter

Available in three styles to handle stock up to ⅛ in. thick, the stock lifters illustrated cut time and cost in construction of progressive dies. The die maker has only to locate the unit and drill two holes, one of which is tapped for the retaining screw. To install the lifter, he drops the lifter and spring in one hole and secures it with the socket-head retaining screw in the tapped hole.

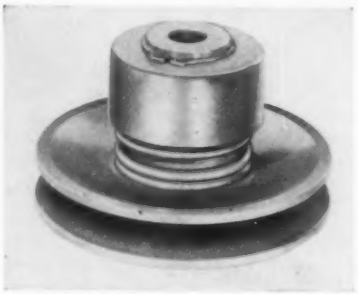


Replacement of a broken spring or lifter can be accomplished in minutes without removing the die from the press. The lifters are available with travels from ½ to 3 in.

Kenville Tool and Engineering Co., 2026 Beach St., Flint 3, Mich. **Circle 371**

Variable Speed Pulleys

A line of economical variable speed pulleys has been developed for low-cost installation. The series consists of five sizes ranging from fractional to 1 hp, with speed ratios up to 2.8 to 1.

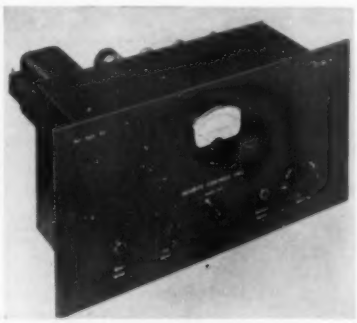


The pulleys are as easy to install as an ordinary V-Belt drive, yet permit accurate adjustment over a wide range of speeds. Construction features include curved pulley faces for full belt contact, high ratio for small face diam, positive lubrication and compact, lightweight construction.

Lovejoy Flexible Coupling Co., 4978 W. Lake St., Chicago 44, Ill. **Circle 372**

Sensing Control

Redesigned and broadened in its applications, this electronic sensing control recognizes metallic and nonmetallic objects, without physical contact, as they enter a capacity field.



Model 400 is recommended where switches are impracticable. The device can be set up to any given constant at a given time interval. It is available in chassis form for panel mounting (illustrated) or in a key-locked, shock-mounted and gasketed cabinet.

Not only does the unit recognize errors or deviations from the constant,

as objects enter the field, but it indicates whether the sensed objects are too large or too small, too far or too near to a predetermined position or setting. Detection is expressed in numerous ways, such as stopping a machine, actuating a rejecting or correcting device (via plus-minus relays) or signaling for action by an attendant.

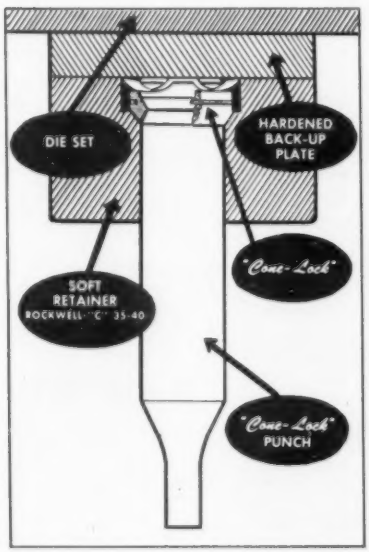
Among uses for the control are detecting variations in flow of material in chute; discovering undesirable areas in continuous strip material; signaling improper nesting of blank in press die; revealing broken bits on automatic drilling and tapping machines; sizing and measuring parts and products on conveyor; and actuating solenoids, correcting or rejecting mechanisms, counters and audible or visual signals.

Security Controls, Inc., 503 Franklin St., Buffalo 2, N. Y. **Circle 373**

USE READER SERVICE CARD ON PAGE 169 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Punch Retainer

Punches can be pushed by hand into the retainer illustrated, and can be removed with a pull wrench while the die is in the press No built-in devices are required to hold the punch. The retainer is of soft steel (35-40 R_C). A



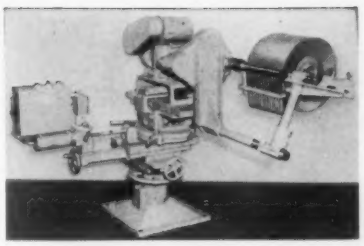
hardened back-up plate is mounted between the retainer and the die set. When a punch is pushed into the retainer, the Cone-Lock expands, then locks firmly on the fully seated punch. Retainers for punches from ¼ to 1-in. diam are available.

Pivot Punch and Die Corp., North Tonawanda, N. Y. **Circle 374**

Buffing Machine

Automatic buffing of parts which have obstructions that prevent complete rotation is possible on this Model E-10 machine equipped with an air cylinder advance and oscillating arm fixture.

Parts such as ratchet type wrench heads are mounted on an arbor which is then positioned in the oscillating arm by an air-powered tailstock. The parts advance into contact with the buffing wheel by air cylinder control. A timed sequence of the arm through an arc of oscillation adjustable from 0 to 360

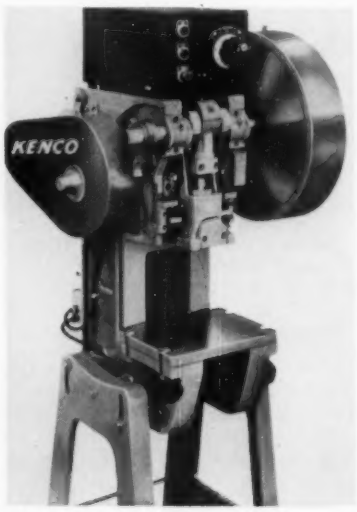


deg gives the desired wheel contact time at the desired part area.

Acme Mfg. Co., 1400 E. Nine Mile Rd., Detroit 20, Mich. **Circle 375**

High Speed Presses

Built in 5, 8, 12, 15 and 18 ton capacities, Electro-Safe presses meet requirements of high speed production and provide for effective use of automatic tooling arrangements. The built-in controls are readily interlocked with the checking and safety devices often desirable in high production.



The press drive has no clutch or flywheel, eliminating loading cycle hazards and permitting instantaneous stop or start of the press at any point of the stroke. A key-locked selector switch can be set to any of three positions, "continuous," "single trip" or "inch." The rotary cam limit switch can be adjusted to stop the press at any point of the stroke.

The presses can be used in multiple units for punching, forming, blanking or bending of long extruded shapes. A full range of shut heights and stroke lengths is offered.

Kenco Mfg. Co., 5211 Telegraph Rd., Los Angeles 22, Calif. **Circle 376**

USE READER SERVICE CARD ON PAGE 169 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Automatic Screw Feeder

Designed for vertical screw driving operations, an automatic screw feeder eliminates manual screw placement, is set at the factory to drive specific types of screws, and can be used with all makes of pneumatic and electrical tools to feed and position all types of screw fasteners.

A hopper holds the screws and an elevator picks up the screws and feeds them, one at a time, through a plastic tube by gravity with each driving stroke of the tool. As the screw is set under the driving blade, a collet holds the screw in place.

The feeder is effective for long-run production, particularly in the assembly of appliances, electrical and electronic components, and in metalworking and woodworking applications which require continuous screw driving operations.

Wales-Strippit, Inc., 211 Buell Rd., Akron, N. Y. **Circle 377**

Self-Fluxing Brazing Alloys

Intended for high-temperature service applications, a line of Nicrobraz self-fluxing brazing alloys contains a vaporizing flux that permits brazing difficult alloys such as aluminum and titanium-bearing metals in hydrogen and argon atmospheres. Addition of the vaporizing flux does not change present alloy specifications or properties and has no deleterious effect on joint properties. The flux will not attack any known base metal and leaves no residue.

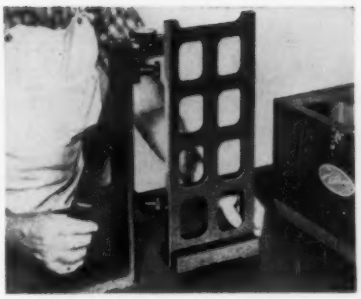
Wall Colmonoy Corp., 19345 John R. St., Detroit 3, Mich. **Circle 378**

Indicator Gage

Primarily designed to provide a quick and simple means for toolroom, inspection and production personnel to accurately check 90-deg work angles, this indicator gage can also be used in conjunction with the company's angular plates to check the precision of angles other than 90 deg. Such items as mounted die details can be checked for relative position by using gage blocks in combination with the indicator gage.

The gage is furnished with dial indicator, "master" square, and a hinged hardwood box for protective storage. It has A.G.A. mounting and instantly registers plus or minus errors in workpiece to 0.0001 in.

Distance between the two contact points can be quickly changed over a range from 1⅛ to 17¾ in. Hand screws



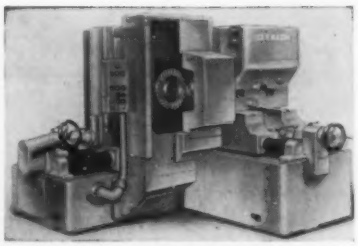
on both contact point brackets are easily loosened and tightened when making this adjustment. Contact point brackets are spring loaded to prevent inadvertent slipping while spacing adjustments are being made.

Omer E. Robbins Co., 11961 Dixie Ave., Detroit 39, Mich. **Circle 379**

Bevel, Gear Test Machine

Gears up to 36-in. diam and shaft angles from 10 to 130 deg can be tested with the variable speed bevel and hypoid gear test machine illustrated. Besides testing for location of tooth bearing area, the No. 138 tester can check for quiet operation at any speed from 200 to 2000 rpm, and during acceleration and deceleration.

The gear pair is mounted in the machine with the proper backlash, and run together under a light brake load for a noise test at the various speeds. A marking compound, applied before the test, shows the tooth bearing areas after the gears are stopped.



The gears can also be run together without backlash. In this "slow roll" test, a light spring tension holds the gears in metal-to-metal contact, and a dial indicator shows the composite error in runout and tooth spacing.

Gleason Works, 1000 University Ave., Rochester, N. Y. **Circle 380**

Crystal Can Solderer

The Reevelec automatic miniature crystal can solderer consists of an induction heating generator with special tooling. It eliminates the time and expense of soldering miniature crystal cans and also provides a decrease in rejects due to heat caused frequency changes. The soldering job is 95 to 100 percent efficient in the elimination of leakers. No flux enters the can to cause crystal damage.

The basic equipment consists of Model L4D, 1-kw induction generator; a special variable speed, motordriven, 16 station turntable on which the generator is mounted and connected; spring-loaded holding jigs in which the crystals are assembled and held; two-stage heating coil where soldering takes place; fluxing assembly which applies the proper amount of flux to the outside of the assembly after the first heating cycle; and operator controls and switching circuitry to synchronize the generator and turntable.

Reeve Electronics, Inc., 609 W. Lake St., Chicago 6, Ill. **Circle 381**

Direct Measuring Instrument for Lathes

The Distometer provides the lathe operator with a fast, convenient, reliable means of spotting tool position and directly measuring longitudinal cutting distance.

Model 55 B-245 provides a constant operator guide which operates over the full travel of the lathe carriage, can be referenced instantly at any point in the travel with push-button zeroing, and can measure movement continuously to any other point.

Dial graduations are in increments of 0.002 in. and the range per revolution of the pointer is 0.500 in. A revolution counter is divided into 10 segments, each of which represents one complete revolution of the large hand. The instrument is mounted on the lathe carriage and travels with the tool; is actuated by its movement along a stationary tape mounted rigidly to the lathe bed; and is equally effective whether cutting shoulders, grooves, or bores.

Federal Products Corp., 1144 Eddy Street, Providence, R. I. **Circle 382**

USE READER SERVICE CARD ON PAGE 169 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

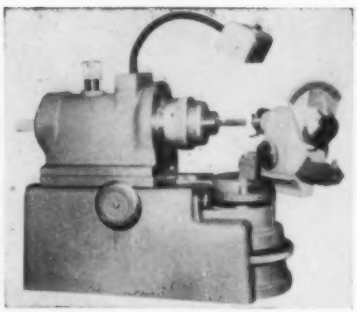
Tool Analyzer

Originally intended for inspection and qualification of taps, a tool analyser will accommodate other small tools including drills, reamers, end mills, broaches, counter bores and hobs. The instrument is versatile and fast in operation.

Measuring principle incorporates a monocular, zero-parallax optical system with magnifications up to 40X. The tool to be inspected is accurately checked

in relation to index, view angle and dimensional scales. Readings to 0.0001 in. may then be taken.

All readings are made at one setting, eliminating transfer errors. Shank tools are referenced on the shank in the identical manner in which the tool is used. The tool analyser will accommodate shank diameters from 0.006 in. to 1⅜ in. with standard equipment. The regular chuck head can be removed and replaced by special fixturing so that



the range of the instrument is increased and tools or workpieces without shanks may also be observed.

Accessories include collets, chucks, arbors and optics which are interchangeable so that many tool sizes can be accommodated.

Stocker & Yale, Inc., 40 Green St., Marblehead, Mass. **Circle 383**

Skip Punching Device

Originally designed to control the slotting of motor laminations by notching machines according to a specified pattern of slots and spaces, a skip punching device has been successfully adapted for use in inclinable power presses where the work involves a repetitive pattern of punching and skipped strokes.

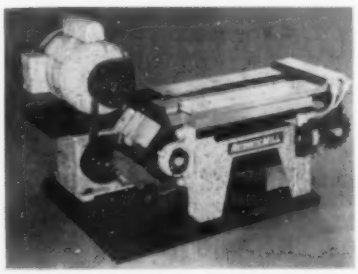
Although the unit becomes an integral part of the press when the control counter is set, the skip punching device can be disengaged and the press operated in the conventional manner simply by not setting the counter.

The device consists of an operating cam (built into the press slide) that is actuated by a double-acting air cylinder. The air cylinder is controlled by a repeating counter that can be set to suit the required pattern.

Emhart Mfg. Co., Hudson Div., Hudson, N. Y. **Circle 384**

Automatic Milling Machine

Designed for high-speed production milling of small parts in large quantities, the machine illustrated employs a powerful chain drive to continuously move a matched set of holding fixtures at such speeds beneath the milling cutter that 500 to 6000 parts are machined per hour. Hand loading of jaw cavities



is used for runs up to 500,000 parts; for longer runs it is economical to install hopper feeding. The unit can be attached to the bed of any milling machine or can be obtained with a built-in precision milling head.

Sieburg Industries Inc., Danbury Industrial Park, Danbury, Conn. **Circle 385**

Bending Machine

Designed for moderate-production bending of pipes, tubes, angles, channels and other structural shapes, S-M bending machines are available in four

sizes for handling work from 2-in. standard pipe to 6-in. standard pipe. Hydraulic power makes possible 90-deg bends (plus springback) in one setting; 180-deg bends (plus springback) in two settings.

Wallace Supplies Mfg. Co., 1304 Diversey Parkway, Chicago 14, Ill. **Circle 386**

USE READER SERVICE CARD ON PAGE 169 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Motorized Micrometers

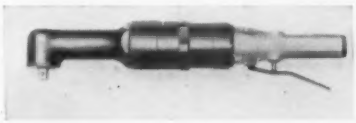
Dead weight micrometers are motorized to eliminate variables in measuring caused by differences in the pressure applied. The cam which lowers the dead weight measuring load loses contact with the load during the dwell period when the measurement is noted. The operator's hands are free for handling sheet and making notations.

With most variables eliminated, measurements should not vary from operator to operator or plant to plant and measurements in compressible sheet materials such as plastics, paper, and paperboard can be made with greater confidence.

Testing Machines, Inc., Mineola, Long Island, N. Y. **Circle 387**

Angle-Head Air Tools

With a rated capacity of ¼ in., these angle-head reversible screwdrivers and



nutrunners are available with the choice of two throttle types, lever and lock button; three different spindles, ¼-in. square, ⅜-in. square and ¼-in. female hexagon; and four speeds, 1750, 1000, 700 and 500 rpm. Weight is from 2⅛ to 2¼ lb; head length is a maximum of 11⅝ in. Air pressure of 90-100 psi and ¼-in. ID hose are recommended.

Buckeye Tools Corp., 5003 Springboro Pike, Dayton 1, Ohio. **Circle 388**

High-Strength Adhesive

Developed for automatic spray application in volume production operations and for bonding a wide variety of

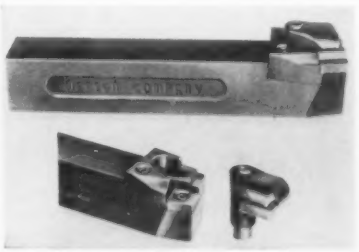
porous and nonporous materials, EC-1390 adhesive has a high softening point and excellent resistance to plastic flow. Typical uses are bonding aluminum facings to paper honeycomb cores in sandwich panel construction; bonding aluminum sheeting to tempered masonite; bonding porcelainized steel to plywood; and bonding insulation material to galvanized steel.

Wood-to-steel bonds have shear strengths in the range of 400 psi. High-pressure plastic laminate-to-steel bonds have tensile-sheer strengths of 400 psi and peel strengths averaging 50 lb per inch width.

Adhesives and Coatings Div., Minnesota Mining and Mfg. Co., 900 Bush Ave., St. Paul 6, Minn. **Circle 389**

Throwaway Holders

Consisting of only two major subassemblies—a shank assembly and a chipbreaker and clamp assembly—each tool of the T-A line of throwaway holders has only eight parts. Individual components are designed so the more perishable parts are the least complicated and least costly to replace.



The cast steel anvil locator is pinned to the shank with removable compression pins. A differential screw fastens the vise-jaw clamp onto an adjustable carbide chipbreaker to form the second major subassembly. The screw can be operated from the top or bottom of the tool holder. It both clamps the insert and elevates the chipbreaker for insert indexing.

The toolholder is available in 112 standard shank styles and sizes.

Wesson Co., 1220 Woodward Heights Blvd., Ferndale 20, Mich. **Circle 390**

Stainless-Steel Gage Blocks

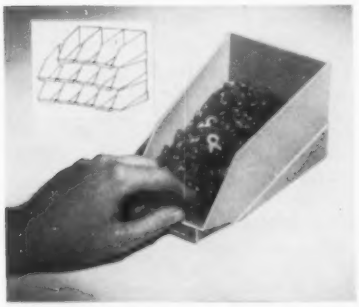
Wearing three times longer than gage blocks made from regular steel, stainless-steel gage blocks are also three to

four times as resistant to nicks and burrs as blocks made from conventional gage block steels. Rust and corrosion are minimized and, since the stainless steel material has high density, there are no minute surface pits or cavities that could interfere with comparator readings. Because of their durability, the stainless steel blocks are well adapted to production-floor use.

The DoAll Co., Des Plaines, Ill. **Circle 391**

Stacking Bins

Lightweight molded plastic assembly bins provide speed and convenience in small parts assembly. There is no magnetic interference and no corrosion of paint.



Tapered fronts permit convenient semicircle setup and sloping bottoms provide natural forward flow of parts. The bins can be arranged and rearranged easily and quickly to suit changing requirements.

The Model A-10 bins are 8 in. long, 2½ in. high, 3¼ in. wide at front and 4½ in. wide at the rear.

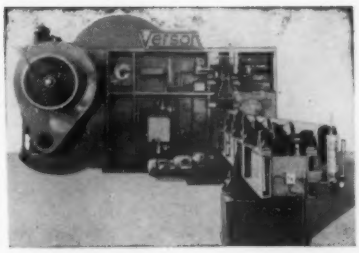
Stackbin Corp., Pawtucket, R. I. **Circle 392**

USE READER SERVICE CARD ON PAGE 169 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Bar Billet Shear

Rated at 700 ton, 1.9 in. up at point of shear, a heavy duty bar billet shear has capacity to shear 4-in. SAE 5140, 115,000 tensile strength bars. Production rate is 32 spm with a 4-in. stroke at point of shear. It will shear billets up to 6 in. long at this speed or an 8-in. long billet at 25 spm.

Weight of sheared billets is held to a tolerance of plus or minus three oz. Shear cut length tolerance is plus or minus 0.020 in. Minimum lengths that can be sheared are 75 percent of the



distance across flats of round corner square stock or 75 percent of the diameter of round stock.

Operation of the shear is completely automatic. The machine incorporates power feed conveyor, length gauge, outboard support, hold down and automatic lubrication. Operating conditions can be selected to provide continuous operation, single stroke-automatic, once-automatic, once-shear only and inch-shear only. Manual operation can be selected for the hold-down, outboard support and length gage to permit operation of these accessories without running the shear.

Verson Allsteel Press Co., 9300 S. Kenwood Ave., Chicago 19, Ill. **Circle 393**

Vibratory Finishing Machine

Need for manual loading and unloading of parts and media is eliminated in the improved model Vibratron. A built-in, removable, double-decked, vibrating separator in the base of the machine separates parts and media, as well as fragments from the media, in one simple operation. An extra separator is not needed.

The machine can be conveyor-fed, hopper-fed or manually loaded with a hoist, if desired. The new design permits discharge of finished parts onto a conveyor where they move on to the next operation.

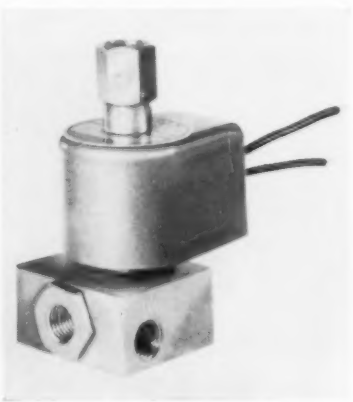
Primarily designed to finish complex

cast, forged, stamped, and machined parts with hard-to-reach shielded and internal surfaces, the machine utilizes very short time cycles. With automatic discharge onto a conveyor, the Vibratron may be made a part of a production line.

Roto-Finish Co., Kalamazoo, Mich., **Circle 394**

Solenoid Valves

Three-way quick exhaust solenoid valves have an oversized ¼-in. diam exhaust orifice, eliminating the need for connecting a separate quick bleed valve



in the circuit to speed up the exhaust cycle. They have brass bar stock bodies with ¼-in. N.P.T. connections. Disks are resilient nylon, providing tight seating on air, gas, water and light hydraulic oil up to 160 psi. Valves may be mounted in any position without affecting operation.

Forms of operation available are normally closed, normally open and universal. They are available in voltages up to 550 v, 60 cycles. NEMA I (general purpose), NEMA IV (watertight) or NEMA VII, IX and IXA (explosion-proof) solenoid enclosures also are available.

Automatic Switch Co., Florham Park, N. J. **Circle 395**

Electronic Comparator

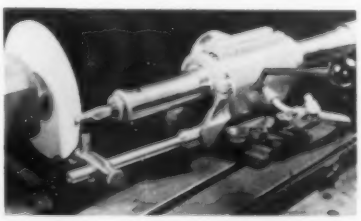
Designed for efficient and accurate manual inspection of small parts, the RCA limit signaling comparator operates on radio frequency and gives instantaneous response. Containing no amplification circuits, the 14½ x 8½ x 9¼-in. instrument plugs into a 110-v outlet.

High, low and acceptable limit lights on the meter panel provide instant information to the operator. The gage head can be adjusted so that the desired size of the part under examination is indicated on the meter as an acceptable standard. Nine different gage heads are available, permitting direct readings ranging from 0.000050 to 0.001 in. per dimension.

Radio Corporation of America, 30 Rockefeller Plaza, New York 20, N. Y. **Circle 396**

Tool Sharpener

Operating virtually without friction, the "Air-Flo" sharpens end mills and routers. The attachment has a porting system engineered to eliminate all metal contact of the spindle which floats on a cushion of air, giving the operator's hand a super-sensitive feel. Compressed air is supplied to the unit by either the shop compressor or from an inert gas tank.

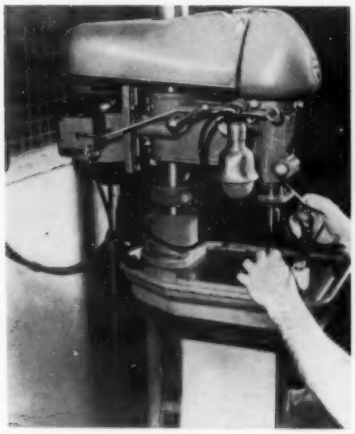


The attachment grinds straight or tapered end mills, both on periphery and ends. Also ground are routers, shell mills, step drill margins, stagger tooth cutters and specials. Shank sizes up to 1¼-in. diam are accommodated on the standard model: larger sizes available on special order.

Steptool Corp., 3613 Olympic Blvd., Los Angeles 23, Calif. **Circle 397**

Sensitive Drill Press

Available in single-spindle models or with any number of spindles in multiple-spindle setups, this 14-in. drill press has speeds up to 12,000 rpm. The machine is intended for high-speed, small-hole drilling of all drillable materials,

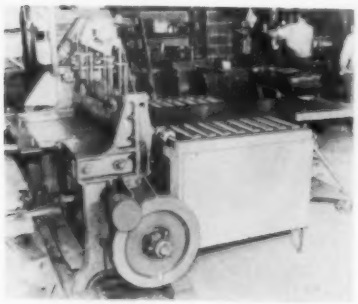


particularly precious metals, phenolics and nonferrous metals such as aluminum, brass and copper. Drill breakage and work spoilage is reduced by a counterbalanced quill that eliminates quill drop at break-through on through holes.

Rockwell Mfg. Co., Walker-Turner Div., Dept. 1012, 400 N. Lexington Ave., Pittsburgh, Pa. **Circle 398**

Automatic Shear Feed

Shear production per man-day with the shear feed illustrated exceeds other methods of shearing large sheet accurately. The operator need handle uncut stock only when it is placed in the shear feed; thereafter he works only with sheared blank, and feeding is completely automatic.



With automatic transmission added to the unit shear feed, after a blank has been sheared the remainder of the sheet can be propelled away from shear blades to allow space for trim-cutting blank. Scrap pieces of sheet can also be removed.

The shear feed is available with forward and reverse transmission or with reverse action only. It is caster-mounted for portability.

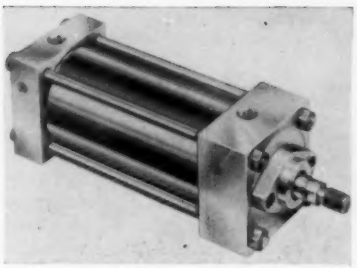
American Actuator Corp. P. O. Box 384, Stamford, Conn. **Circle 399**

Power Cylinders

Powrmation cylinders are furnished in 1½ in. through 8-in. bores; capacities are 250 psi air to 1000 psi hydraulic, depending on bore size. A variety of mountings, rod diameters and rod ends makes these cylinders adaptable to practically any type of installation. Mountings include side lug, center lug, basic, tie rod, flush side, front flange, rear flange, trunnion, clevis and double-rod style.

Strokes can be made to any practical length. An extra-long bearing available with an optional gland makes internal spacers unnecessary in many long-stroke cylinders.

There is a choice of packings to meet high or low-temperature requirements. Standardized boots and rod scrapers give the cylinders added protection in extremely dirty or dusty installations.

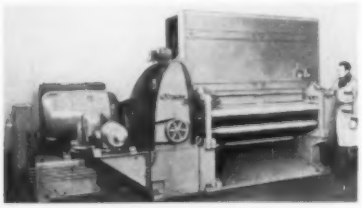


Hanna Engineering Works, 1765 Elston Ave., Chicago 22, Ill. **Circle 400**

USE READER SERVICE CARD ON PAGE 169 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Sheet Polishing Mill

Providing continuous abrasive belt finishing of metal sheets, plate and coils at feeds from 20 to 60 fpm, this 74-in. unit has a 150-hp main drive motor and a 75-in. belt width. Mills are also available for handling stock in widths of 30, 40 and 54 in.



Basic design of the mills can be altered to suit specifications of any operation. When stock removal on sizing operations is within 0.010 in., a thickness tolerance of ±0.001 in. on the finished sheet can be consistently produced with a sufficient number of passes.

Acme Mfg. Co., 1400 E. Nine Mile Rd., Detroit 20, Mich. **Circle 401**

Solenoid Air Valves

Single and double solenoid four-way, three-way, and four-way five-port types are available in ¼, ⅜ and ¾-in. sizes. Manual screwdriver or ball type operators are standard on all solenoids. Valves can be set to locked-in or locked-out position.

The valve requires no accessories, since interchangeable solenoids and plug-in electrical connectors are included in the basic design.

Mechanical Air Controls, 10030 Capital Ave., Detroit 37, Mich. **Circle 402**

Cutter Grinding Fixture

Plain milling cutters up to 6 in. in diam can be ground and sharpened on a horizontal surface grinder with this cutter grinding fixture. In some shops it eliminates the need for a universal tool and cutter grinding machine.

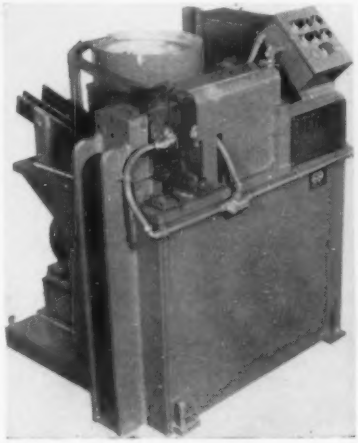
The fixture's coating is Meehanite and all working surfaces are hardened and ground. The base is 4-in. square; overall height is 6 in.; and weight is 5 lb. It will hold all plain milling cutters up to 6-in diam and with bores of ⅞, 1 and 1¼ in.

Montgomery & Co., Inc., 401 Morris Ave., Springfield, N. J. **Circle 403**

USE READER SERVICE CARD ON PAGE 169 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Assembly Press

One of a line of precision industrial presses, this special three-ton horizontal hydraulic press was designed to assemble a bushing into a converter stator support. Both parts are fed to pressing position by gravity. The stator support rolls freely to assembly position and upon assembly of the bushing it is released to roll through and unload.

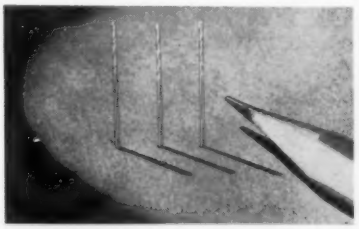


The bushing detail is hopper fed and dropped into the pressing position automatically, where it is picked up by the ram adaptor and pressed into the stator support. Pressing speed is approximately 192 ipm. Production is estimated at 1200 pieces per hour at 80 percent efficiency.

Detroit Broach and Machine Co., Rochester, Mich. **Circle 406**

Carbide Drills

Made in wire sizes No. 61 through 80, with diameters ranging from 0.0135 to 0.0390 in., series 1815 drills fill out a line of wire drill sizes from No. 1 through 80.

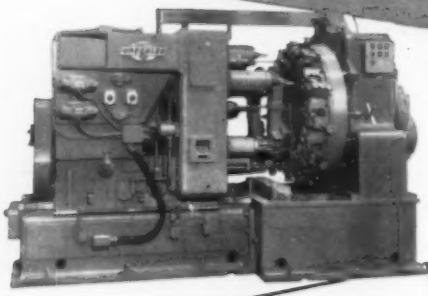


The carbide Micro-Drill is recommended for drilling plastics, fiber, Fiberglas, carbon and other nonferrous material. It is also suited for precision drilling in electronic circuit board work.

The Atrax Co., Newington, Conn. **Circle 407**

. . . an example of Automatic Production by Greenlee . . .

MMT=PE



97 cast iron oil pump bodies an hour

This Greenlee 12-station, horizontal indexing machine rough and finish machines cast iron oil-pump bodies for a leading auto producer at the rate of 97 pieces per hour. Indexing is fully automatic. Cycle time is 37.2 seconds. Tolerances of ± .001" for boring depth and ± .0005" for ream hole size are maintained.

STATION 1 — load, unload
STATION 2 — drill
STATION 3 — drill
STATION 4 — drill, chamfer
STATION 5 — rough bore
STATION 6 — rough ream
STATION 7 — rough bore
STATION 8 — semi-finish bore
STATION 9 — semi-finish bore
STATION 10 — finish ream, finish bore
STATION 11 — finish ream
STATION 12 — finish ream, finish bore

Let a Greenlee representative show you the modern Greenlee cooperative engineering approach to automatic production.

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GREENLEE

TRANSFER MACHINES
STANDARD AND SPECIAL MACHINE TOOLS

- Multiple-Spindle Drilling and Tapping Machines
- Six and Four-Spindle Automatic Bar Machines
- Die Casting Machines
- Trim Presses
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Lightweight Solenoid Valve

Having about three times the flow capacity-to-solenoid size of most comparable air valves, the Pacer features cycling in excess of 1000 cpm; full 5/32-in. minimal internal orifice (NC side) requiring only 7 watts power; short poppet travel; dust and liquid-tight seal; 20-oz aluminum body; integral

wiring space; and is designed according to JIC specifications. Available in three-way or four-way models, the Pacer can be manually actuated and is inoperative if the captive cover is removed. The four-way model handles an air service range of 15 to 150 psig. Pipe sizes accommodated are 1/8 and 1/4 in.

Ross Operating Valve Co., 120 E. Golden Gate Ave., Detroit 3, Mich. **Circle 408**

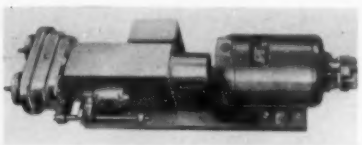
Luminous-Wall Furnace

Capable of attaining temperatures in excess of 2000 F within 10 min. after ignition, a heat-treating furnace with a "luminous wall" gives uniform and almost instant radiant heat. A controlled mixture of gas and air passes uniformly through a special porous refractory lining, encased in a steel shell. A pilot light in the furnace chamber ignites the gas-air mixture as it leaves the porous firing wall. The mixture acts as a coolant for the refractory, which serves as a heat exchanger. The furnace can be rapidly cooled by pumping air alone through the wall.

The A. F. Holden Co., Detroit, Mich. **Circle 409**

High Production Drilling Unit

This self-contained hydraulically actuated drilling unit is of the quill type and mounts in any position. Spindle speeds are 1200 rpm or more; thrust is 600 lb; maximum stroke is 4 in.; cycles



per hour is 0-3000. Units can be supplied as single-spindle models or with multiple-spindle heads. All units are engineered to suit specific applications and are built from mass-produced components.

John S. Barnes Corp., 315 South Madison St., Rockford, Ill. **Circle 410**

RPM Counter

Miniaturized, shaft-drive revolution counter counts shaft revolutions up to 1000 rpm and requires only 1¼ oz-in torque for dependable electrical control of a machine or system operation. Repeatability is ±0.0025 of dial range.

With its clutch energized by external momentary or sustained switch contact, the counter will indicate revolutions of a machine drive shaft until a predetermined dial setting is reached, tripping the control contacts.

Once adjusted to range, the dial setting remains fixed for repeated operation, providing automatic control for measurement of lengths; for product counting; for material and conveyor feeding; for spring, armature and mill roll winding; and for indexing and drill depth control.

Automatic Timing & Controls, Inc., King of Prussia, Pa. **Circle 411**

Trade Literature

for free booklets and catalogs—use request card, page 169

Industrial Controls

Combining information from several other catalogs to present a comprehensive line, the Industrial Controls catalog lists many General Controls products, including automatic temperature, pressure, level and flow controls, counters, switches and automation controls. Also illustrated and described are industrial actuators, combustion instrument controls, controller indicators and pressure indicators. One section covers Hydramotors, electro-hydraulic acutators having many patterns, designs and valve body materials. The Hammel-Dahl and Foster Engineering Div. lines, as well as relays, transformers, and time switches, are also shown in the catalog. General Controls Co. **Circle 301**

Coolant Cleaning Equipment

Use of BarnesdriL Kleenall fabric filters and combination magnetic and fabric filters is covered in an illustrated, eight-page brochure. Production savings are outlined, the operation of the equipment is explained, and applications are shown. The filters automatically remove sludge from coolant in grinders, gear shavers, automatic screw machines, broaching machines, super finishers, milling machines, deep hole drills, and thread rolling machines. Barnes Drill Co. **Circle 302**

Machine Shop Accessories

Catalog No. 37A lists arbors, adapters, collets and other machine shop accessories. Important features and characteristics of products are listed compactly so that materials, limits, and other features are easily determined. An illustrated index facilitates use of the catalog. Brown & Sharpe Mfg. Co. **Circle 303**

Hard Facing

Plasma jet coatings, metal and ceramic spraying, and other hard facing services for industry are described in a six-page illustrated brochure. Complete specifications and typical applications for the various processes are listed in individual sections. Cleveland Hard Facing, Inc. **Circle 304**

Drilling, Tapping Units

Technical data on operation and selection of automatic drilling and tapping units, air or hydraulic powered, and the various uses to which the units can be adapted are presented in a 12-page illustrated booklet. Hypneumat, Inc. **Circle 305**

Process Timers

Bulletin GEZ-2985 describes Type TSA-14 adjustable "on" time units for controlling operating cycles. The four-page brochure includes a description of features and application, ratings, dimensions, prices, and ordering directions. General Electric Co. **Circle 306**

Trade Literature

Government Specifications

One thousand official U. S. Government specifications covering adhesives, sealants, paints, cleaning compounds, and chemical compounds are listed in the new edition of a catalog useful to purchasing and procurement officials of companies handling Government contracts, or those who need products conforming to Government specifications.

The catalog is divided into eight sections according to Federal class numbers and has a complete numerical index. The specifications are listed by Government number, title and corresponding Magic Chemical Co. product number.

Because such a broad field of products is covered, this catalog is useful in commercial applications. Magic Chemical Co. **Circle 307**

Titanium Welding

Methods for welding titanium piping and tubing by the gas tungsten-arc process are explained in a 24-page report. A complete description is given, from an explanation of the welding process to the selection of electrode and filler metal. Contents include process, power supply, electrodes and filler metal; titanium grades, joint design and preparation; cleaning, gas shielding, welding techniques, heat treatment and weld quality tests. American Welding Society. **Circle 308**

Tape Recorder, Reproducer

Two models of digital magnetic tape recorder-reproducer systems are described in an illustrated four-page brochure. Model 5-681 operates at speeds up to 30 ips, and the 5-682, a high-speed transport, operates up to 150 ips. Both are designed to meet a broad range of computer, industrial, military and laboratory requirements. A detailed description of operating characteristics and specifications for both units are included. Consolidated Electrodynamics Corp. **Circle 309**

Machining Thermoplastics

Recommended procedures for machining and finishing of thermoplastic sheets, rods and tubes are outlined in an eight-page booklet. Procedures discussed include sawing, routing, drilling, turning, shearing, punching, grinding and finishing. General recommendations for tool design, feed and speed, and use of coolants are presented. Special machining characteristics of acrylics, nylon, fluorocarbons and polyethylene are also covered. Cadillac Plastic & Chemical Co. **Circle 310**

Tube Forming

Aircraft engineering data and other important information on the fabrication of tight bend tubes are included in a bulletin which describes how the bends are formed through a cold process method to extremely short radius bends of 1:1 ratio, or less. The bends are fabricated from aluminum, steel, stainless steel and other alloys in sizes ranging from ½ to 3-in. tube O.D. Aeroquip Corp. **Circle 311**

Milling Cutters

Bulletin 52-59 contains 16 pages of technical data on milling cutters with descriptions, illustrations, sizes and prices of these and other cutters. It offers information on time and money saving production problems. Aber Engineering Works, Inc. **Circle 312**

Thread and Form Grinding Machines

Sheffield Model No. 101 and 103 precision thread and form grinding machines with Crushtrue threading applications are described in a 12-page catalog, TFG-11-59. The machines are designed for both production and toolroom thread and form grinding. Additionally, the machines are used for pass-over grinding of threads up to 80 pitch and for grinding long single and multi-start threads with either diamond true multi-rib or single-point wheels. The Sheffield Corp. **Circle 313**

Industrial Application

An illustrated eight-page bulletin, "Devcon Products for Tooling," describes how Allis Chalmers, Hotpoint, Pratt and Whitney Machine Co., and other manufacturers have saved time and reduced costs in their tooling programs by using Devcon materials. Employing case histories, the bulletin gives details of successful applications of Devcon in making jigs, fixtures, metal forming dies, duplicating masters and other tools. Devcon Corp. **Circle 314**

Aircraft Steels

Aircraft steels AM-350 and AM-355 are described in detail in a 24-page booklet. Included is information on the mechanical and physical properties of the steels at various temperatures, and sections on heat treating, fabrication, including forming, forging, welding, brazing, and machining. Numerous tables give detailed data.

The steels can be used for applications including flat and coiled springs, corrosion resistant fasteners, dental and surgical equipment, saws and saw blades, piston rings, glass molds, and pump and camera parts. Allegheny Ludlum Steel Corp. **Circle 315**

Control Devices

General purpose control catalog, GEC-1260D, is a 72-page publication containing information on a complete line of control devices. Horsepower selection charts are listed for motors from one-fourth through 200 hp, providing quick selection of starters, heaters and push button stations necessary for control of these motors.

The illustrated catalog includes complete product description of both manual and magnetic motor starters, contactors, relays, solonoids, limit switches, push buttons, static control and pilot devices. Pricing tables for each device are listed. Features, wiring diagrams, dimensions and application information for each device are also included. General Electric Co. **Circle 316**

Variable-Speed Sheaves

Bulletin No. 6102 illustrates and describes the stationary control SVS variable-speed sheave for standard V-belts. The tool's nonfreezing construction, method of installation, easy speed change and other features are reviewed. Tables provide assistance in selection of variable-speed and companion sheaves. T. B. Wood's Sons Co. **Circle 317**

Flame-Cutting Machine

Designated the Linagraph, a machine of pantograph design, suitable for straight line and shape cutting on eight-foot steel plate used in medium duty production, is covered in an eight-page brochure. The illustrated catalog covers the design, construction and operation of the machine. Air Reduction Sales Co. **Circle 318**

Machines

General Catalog 1-2 describes the basic design features of all Heald machines and covers the various models of Bore-Matics, internal grinders, rotary surface grinders, tool sharpeners, boringheads and wheelheads, and attachments available. Short descriptions of each model in the line are given, the model is pictured and basic specifications are listed.

Thirteen Bore-Matics are described including single and double end horizontal units, single or multiple slide unit machines in vertical and horizontal arrangements, and vertical and horizontal cam operated machines.

Twenty-four internal grinding machines are described. These include multi-purpose chuck types, automatic chuck types, roll type and shoe type centerless grinders, and chucker types.

Heald rotaries are listed in three sizes of vertical column machines. Twelve attachments are illustrated. The Heald Machine Co. **Circle 319**

Trade Literature

Tooling System

How the V.B.U. system of tooling cuts costs and speeds production on complex multi-point and multi-diameter tooling is explained in a 24-page catalog. Styles and sizes, including positive, neutral, and negative rakes and varying lead angles, are listed along with engineering data and ordering information. Dimensional drawings accompany each style of cutter body, cartridge, insert, and accessory. Valenite Metals.
Circle 320

Industrial Controls

Directed towards the design and process engineer, a 23-page, two-color booklet is titled "Industrial Temperature Measurement and Control." Filled with charts, drawings, and diagrams, the booklet covers ways of responding to temperature; ways of putting temperature response to work; the Partlow element for mercury-bulb instrumentation; the nine basic Partlow types of controls; and a score sheet for the mercury-bulb system. It also provides basic concepts of electrical, pneumatic and mechanical controls; heat sources and their influence on control systems; circuits and piping arrangements; and first principles of mercury-bulb installation. To illustrate instrumentation and what it can do, six brief case-histories are spotlighted. Partlow Corp. **Circle 321**

Gear Generators

Included in illustrated 32-page bulletin No. 460 are complete specifications of all models in the company's line of gear generators, a description of design and contruction features, application data and information on auxiliary equipment. Farrel-Birmingham Co., Inc.
Circle 322

Hydraulic Shears

Hydraulic shears, ranging in capacity from 8 ft of $\frac{3}{8}$-in. mild steel to 12 ft of $1\frac{1}{2}$-in. mild steel, are described in a bulletin which shows typical models and gives specifications for all models. Also included are descriptions and illustrations of features of design and construction. Verson Allsteel Press Co.
Circle 323

Remote Control

Catalog gives basic engineering data on the hydronic remote control system —a completely closed, hydraulic system for remote motion control or duplication. Included are features, dimensions, accessories, uses, and installation information. Hydronic Corp. **Circle 324**

Shear Knives

Descriptive sections on each of six grades of shear knives, together with recommendations for their specific uses, and descriptions of rotary slitter knives, spacing collars, wearing plates, tinning machine and galvanizing rolls, and punches and dies, are included in an illustrated brochure, "American Shear Knives for Shearing All Metals." American Shear Knife Co. **Circle 325**

Welding Data

Designer's Guide for Welded Construction has been revised to include recent revisions in the Standard American Welding Society Symbols. Bulletin No. 1100.1 contains charts and illustrations providing information on the application of welding symbols and other basic design data on welds. Lincoln Electric Co. **Circle 326**

Conveyor Lubricators

New models of the 110 Series and 700 Series automatic conveyor lubricators are described in an eight-page illustrated catalog. Three fundamental improvements are included in the new design of the 110 Series models and four in the design of the new models of the 700 Series. J. N. Fauver Co., Inc. **Circle 327**

Nickel-Base Alloys

Physical and mechanical properties of two investment casting alloys, GMR-235 and GMR-235D, are described in a 16-page booklet. Both are nickel-base, precipitation-hardening alloys that have found applications in the form of blades, vanes, and wheels in gas turbine engines. The alloys offer the design engineer a wide range of properties from which to select for a particular application. Haynes Stellite Co . **Circle 328**

Power Presses

High-speed power presses are detailed in a four-page folder, No. HS-1. A feature of the brochure is a Press Production Chart designed to help the production engineer or plant manager. Eleven types of presses are illustrated and outlined as a reference guide. The Cleveland Punch & Shear Works Co. **Circle 329**

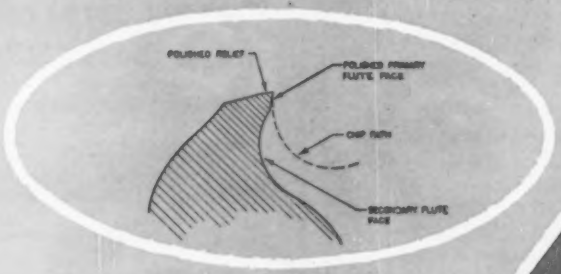
Shim, Gasket Selection

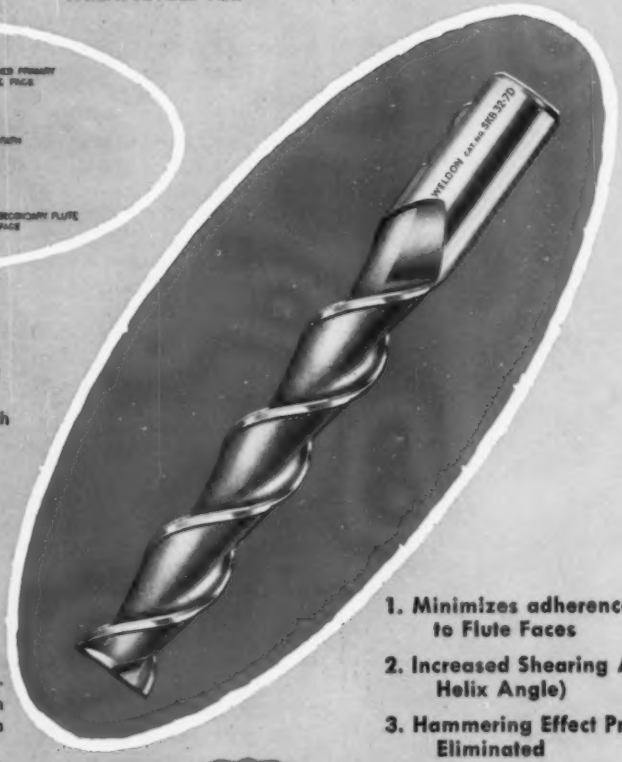
A 1960 edition of the Ready-Reference card, designed to facilitate selection of the various gages of Color-Plast shim and gasket material by color identification, gives a complete listing of the various gages available. Each gage is matched to an identifying color block. The card can be used in engineering and purchasing departments as well as for reference in the shop. General Gasket, Inc. **Circle 330**

WELDON *Ski-Kut* END MILLS

FOR CUTTING ALUMINUM

PATENT APPLIED FOR





CUTTING ALUMINUM MADE EASIER, SMOOTHER AND FASTER

The primary flute face of the Ski-Kut End Mills, being narrow, definitely minimizes adherence of chips to the flute faces. Such adherence or welding of aluminum chips contributes in a major degree to the difficulty in milling aluminum.

Greater feeds, longer tool life, better finish, easier operation of equipment are some of the advantages to be gained by the use of Weldon Ski-Kut End Mills for cutting aluminum.

Weldon SKI-KUT End Mills are available from stock in size from 1/4" to 2" in various lengths. For full information write for folder SKM-1

A RADICALLY NEW DEVELOPMENT IN END MILL DESIGN FOR CUTTING ALUMINUM THAT SPEEDS PRODUCTION AND REDUCES COST.

OVER 40 YEARS OF LEADERSHIP SINCE 1918

1. Minimizes adherence of Chips to Flute Faces
2. Increased Shearing Action(45° Helix Angle)
3. Hammering Effect Practically Eliminated
4. Greater Feeds
5. Longer Tool Life
6. Better Finish
7. Easier Operation

Catalog list numbers are now marked on all Weldon tools and holders as an aid when reordering . . . another WELDON FIRST.

Weldon distributors throughout U. S. A. and Canada carry complete stocks to serve you. SK3

THE WELDON TOOL COMPANY

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Field Notes

Turkey's first project for the production of flat-rolled steel products, including tinplate, has begun with the signing of a letter of intent by the government with three United States concerns for equipment and engineering services totaling about $144 million. The letter covers the first of three stages of development which will eventually provide a yearly output of more than a million tons. The project calls for the Koppers Company, Westinghouse Electric International Company and the Blaw-Knox Company to join in supplying one of the world's most modern integrated steel plants, according to Sabati Ataman, Minister of Industry.

To be located at Eregli, northwest of Ankara on the Black Sea, the initial $185 million installation is scheduled to begin production in 1963 at an annual rate of 268,000 metric tons of flat products and 110,000 tons of ingots. The ingots will be delivered to an older mill at Karabuk, which produces structural products. In its first stage, the plant will provide 50,000 tons of tinplate annually.

expansions

Precision Welder & Flexopress (Canada) Ltd. has completed construction of a manufacturing plant in Toronto, Ontario. The new facility will also house the headquarters offices of the Canadian company. Precision Welder & Flexopress (Canada) Ltd. is affiliated with Precision Welder and Flexopress Corp. of Cincinnati, and will now manufacture as well as market the complete line of welding machines and high speed presses developed by the American Company.

Plans for the construction of a multimillion dollar electron tube manufacturing plant in Brookville, Pa. have been disclosed by Sylvania Electric Products, Inc. Sylvania is a subsidiary of General Telephone & Electronics Corporation. Matthew D. Burns, President of Sylvania Electronic Tubes, a major division of the company, said the new 100,000-sq ft installation will replace three existing facilities located in Brookville. Construction of the facility will begin early in 1960.

Sargent Engineering Corp., Huntington Park, Calif., has established an acoustical test laboratory to conduct noise evaluation and noise reduction studies on hydraulic, mechanical and electromechanical equipment. A study program now underway is designed to lead to the development of hydraulic metering units with reduced noise levels and to provide a realistic basis for valve specification to meet increasingly critical noise requirements.

A. O. Smith Corp. is increasing manufacturing floor space at its Welding Products Division plant in Elkhorn, Wis. by more than 25 percent. The recent plant addition consists of an assembly area that adjoins the former plant structure. The company has also announced purchase of over seven acres of farm land adjoining its Elkhorn plant as insurance for the continued growth of its welding business.

new facilities

A new department aimed at providing a program of continuing assistance to manufacturers in the development of new or improved products and components has been formed by **Chase Brass & Copper Co.**, Inc. This department, designated Product Development, will supplement the company's extensive Metallurgical and Research and Development Departments in technical assistance to customers.

Establishment of commercial testing laboratories for the testing and calibration of industrial instruments has been announced by **Schaevitz Engineering.** To be known as the Schaevitz Testing Laboratories, the new company is the third in the organization of Schaevitz companies. Complete environmental testing facilities will incorporate devices for measuring such parameters as acceleration, vibration, shock, tension, compression, temperature, altitude, humidity and electronic testing.

acquisitions

Chromalloy Corporation, White Plains, N. Y., has acquired Sintercast Corporation of America, Yonkers, N. Y., producer of special tool materials, boron, tungsten and titanium compounds and nuclear reactor metals. Sintercast Corporation of America is active in metallurgical development and holds twenty five patents in this field. The firm was founded in 1947 by the late Erwin Loewy, designer and builder of heavy hydraulic presses and rolling mills and founder of Hydropress Inc., now the Loewy-Hydropress Division of Baldwin-Lima-Hamilton Corp. The operating head of Sintercast, John L. Ellis, and other key personnel will remain in their present positions.

Wheelabrator Corp., Mishawaka, Ind., manufacturer of blast cleaning equipment, steel abrasives, and dust and fume control equipment, has acquired approximately 80 percent of the controlling stock of Lord Chemical Corp., York, Pa. As a majority owned subsidiary of Wheelabrator Corporation, Lord Chemical will continue to operate in York, manufacturing its line of vibratory and barrel type finishing equipment, including compounds and media for cleaning, deburring and precision finishing of metal parts.

new companies

A new firm of consulting engineers, **Dorr Consultants,** has been formed to provide engineering, financial and management services to the chemical process, textile and metallurgical industries. The five founding partners are: John Van Nostrand Dorr, Arthur K. Doolittle, Donald F. Othmer, W. George Parks, and William E. Rudolph. Headquarters of the new organization are at 99 Park Avenue, New York.

John Lang & Sons Limited, Machine Tool Makers of Johnstone, Renfrewshire, Scotland, and the Gisholt Machine Company of Madison, Wis., have announced the formation of a joint manufacturing company to be called Lang Gisholt Machine Company, Ltd. The Company will occupy the existing John Lang & Sons factory at Johnstone near Glasgow, the manufacturing capacity of which will be expanded.

association news

Formation of a new organization for conducting research in the uses of copper and copper products has been announced. Called **Copper Products Development Association, Inc.,** the organization has six major copper producers as charter members. Member companies are: American Metal Climax, Inc.; American Smelting & Refining Company; The Anaconda Company; The International Nickel Company of Canada, Ltd.; Kennecott Copper Corp.; and Phelps Dodge Corp. Any producer of copper is eligible for membership, and participation by other copper companies will be invited shortly. Dr. Clyde Williams, former president of the Bat-

Field Notes

telle Memorial Institute of Columbus, Ohio, has been named technical director pro tem.

The new organization does not presently intend to provide its own facilities for investigations, but will allocate research assignments to individuals, universities and established research organizations. The initial board of directors consists of two members of each of the charter companies.

awards

Timoshenko Medal, given for distinguished contributions to the engineering science of applied mechanics, has been awarded to Sir Richard V. Southwell, former rector of the Imperial College, London, England. Presentation of the award was made at the Annual Meeting of The American Society of Mechanical Engineers in Atlantic City.

Steven J. Kline, associate professor of mechanical engineering at Stanford University received the Society's Melville Prize Medal for his paper, "The Nature of Stall".

Also honored at the Annual Meeting was Charles E. Crede, associate professor of mechanical engineering at California Institute of Technology, who received the first Machine Design Award of the Society.

Award of a $25,000 grant to **Rensselaer Polytechnic Institute,** Troy, N. Y. for research study in the field of packaging management has been announced by the American Management Association. The grant will be drawn from the Fund for the Advancement of Packaging set up by AMA through its National Packaging Exposition Exhibitors' Advisory Committee. Funds are derived from registration receipts at AMA's annual National Packaging Exposition.

RPI will use the grant to study the organization of packaging in a representative sample of industries to determine what organizational characteristics lead to success. The research will cover both the organizational placement of packaging—responsibility, authority, communication procedures—and the characteristics of packaging personnel.

mergers

An agreement to combine **Apex Machine & Tool Co.,** Dayton, O., with Gardner-Denver Co., Quincy, Ill., has been announced jointly by the two companies. Under terms of the agreement Apex will become a wholly owned subsidiary of Gardner-Denver on March 1,

1960 but will continue operations under the same management. Apex is a manufacturer of screwdriver bits and sockets for power tools, as well as universal joints for machinery and aircraft. Gardner-Denver manufactures equipment for construction, petroleum, general industry and mining.

new activities

Engelhard Industries, Inc., supplier and fabricator of platinum and other precious metals has announced the establishment of an Industrial Diamond Division that will import, process and sell industrial diamonds in the U. S. and provide technical service, application engineering and basic research to industrial users of diamonds. The new division, which is located at 113 Astor St., Newark, N. J., will supply both regular natural grit and the selected and treated types of natural diamond that have proved superior in certain industrial applications.

The Nuclear Division of **The Martin Company** has been authorized by the U. S. Atomic Energy Commission to pursue development of a simplified and highly advanced nuclear reactor system. Under the terms of a 17-month AEC contract valued at $838,163, Martin-Nuclear will continue its analyses and tests on the system and will build and operate the first "critical experiment." The experiment is expected to lead to elimination of the need for control rods and complex actuating equipment associated with them.

Contracts for instrumentation systems to automatically monitor and control operations of six new water treatment plants in as many states have been received by Brown Instruments Div. of **Minneapolis-Honeywell** Regulator Co. The pneumatically operated control systems will be installed at municipally owned plants at Lancaster, O.; Oneonta, Ala.; Chanute, Kan.; Glendive, Mont., and at privately owned plants of The Peoria Water Works Co. at Peoria, Ill. and The South Pittsburgh Water Co., Pittsburgh, Pa.

Buckeye Tools Corp. has developed a mobile field clinic that will form a two-way communications link between customers and factory in the proper application of portable air tools. The Dayton, Ohio, firm recently equipped a late model station wagon with representative industrial tools and accessories and is using the wagon to contact customers and field offices on a regular schedule.

Field Notes

Aeronutronic Div. of **Ford Motor Co.** has established a new field office at Huntsville, Alabama, to provide representation with the various missile and space agencies in the area. Gerald J. Lynch, vice president of Ford and general manager of Aeronutronic, announced that Leland C. Pleger, a veteran of eight years in weapon systems analysis and operations research, has been appointed manager of the new Huntsville office.

Pleger will represent the company with the U. S. Army Ordnance Missile Command, the National Aeronautics and Space Administration-Army Ballistic Missile Agency team and other activities in the area. He formerly was manager of Aeronutronic's Operations Research, Advanced Systems Development.

Appointment of **Sturgis Valve & Fitting Corp.**, St. Louis, Mo., as a distributor for Parker industrial tube fittings and tube-working tools, and industrial hose and reusable Hoze-lok fittings is announced by D. A. Cameron, general sales manager-distributors, Parker-Hannifin Corp. The products, widely used in hydraulic and other fluid-handling systems, are furnished by Parker Fittings & Hose Division with plants in Cleveland and Eaton, Ohio and Des Plaines, Illinois.

A grant of $4000 in support of a graduate fellowship in metallurgy from the **Allegheny Ludlum Steel Corp.** has been received by Lehigh University. An unrestricted grant of $500 also has been made as a direct grant to the university as part of the firm's son and daughter scholarship program.

Taylor Machine Works, Inc., Louisville, Miss., is the newest member-company of The Material Handling Institute, Inc. MHI is a national trade association composed of 92 member-companies who manufacture all types of industrial material handling equipment, or offer related industry services. J. M. Ward, secretary, will represent Taylor Machine Works in the national affairs of the Institute.

Expansion of facilities for the production of Karbate impervious graphite heat exchangers has been announced by **National Carbon Company**, Division of Union Carbide Corporation. Scheduled to be in operation early in 1960, the additional manufacturing capacity has been planned to keep pace with the increased demands for shell and tube heat exchangers.

The Dow Metal Products Co., Division of The Dow Chemical Company, has transferred its magnesium and aluminum die-casting production operation from Midland, Mich. to Bay City, Mich. All of Dow's metal casting and fabricating operations are now consolidated in Bay City.

Designed to boost the efficiency of the die-casting operation, the Division will be able to share facilities and services with Dow's sand and permanent-mold foundry and fabrication plant. The die-casting facility has been modernized by relocation in a remodeled factory building and addition of new metal melting and handling equipment.

The Cincinnati Steel Products Co., Cincinnati, has been appointed a distributor of the full line of Olin Aluminum mill products. These products include aluminum sheet, plate, coil, rod, bar, extrusions, pipe and tubing. Cincinnati Steel Products, operates a general line steel warehouse, employing about 40 persons, including a staff of five field salesmen traveling in Kentucky, Tennessee, Indiana, West Virginia and part of Ohio.

David D. Walker, left, has been appointed assistant chief engineer of the Erickson Tool Co. He will direct projects concerned with design of spline and gear-holding devices and will work in research and development of bonding methods and design of special tools. Walker has been associated with the Crane Co. and with Garrison Machine Works.

Henry A. Tobey, right, has been elected vice president-manufacturing, Bearing and Rock Bit Div., The Timken Roller Bearing Co. He succeeds H. M. Richey who retired in December. Tobey joined Timken in 1928 and has served as assistant and bearing factory metallurgist; and as general superintendent, factory manager and general factory manager.

Men at Work

JAMES BURTON DOAN, with the American Tool Works Co. since 1887 when the firm was known as Lodge & Davis, asked for retirement on January 1. Retiring at the same time was J. COLEMAN HUSSEY, SR., who was with the company for 50 years. ROBERT S. ALTER is the new chairman of the board of directors of the company and new board members are JOHN C. HUSSEY, JR., new sales manager for American, and ARTHUR C. NOLTE, newly appointed assistant sales manager.

JOHN H. GREENING has been appointed director of engineering of the Micromatic Hone Corp. He joined the company as a field engineer in 1950, was shifted to development engineering, and was promoted to chief engineer in 1957.

PETER H. PONTA has been appointed director of manufacturing engineering for Ford Motor Co., succeeding J. F. RANDALL, who has been named manager of Ford Div.'s expanded manufacturing engineering operations. At Ford's Engine and Foundry Div., ROBERT STEVENSON has been named general manufacturing manager.

DR. WALTER A. DEAN has been named assistant director of research for Aluminum Company of America. Dr. Dean, with the company for more than 30 years, succeeds WILLIAM T. ENNOR, whose retirement has been announced.

JAY FRIEDMAN has been elected president of the Priority Mfg. Corp. He is also president of Erie Sheet Steel Co.

JOHN F. PROBST has been elected president of South Bend Lathe, Inc., a subsidiary of American Steel Foundries. He succeeds RUSSEL E. FRUSHOUR, who is retiring. Probst has been with the company since 1946.

HERMAN H. WAGGERSHAUSER has been appointed to succeed retiring NEWTON B. GREEN as general manager of the Apparatus and Optical Div. and a vice president of Eastman Kodak Co.

SILAS S. CARTHCART has been elected vice president for corporate planning and will also serve as administrative assistant to the executive vice president of the Illinois Tool Works. JAMES D. NORMAN will succeed him as general manager of the company's Fastex Div.

K. H. Zinsmaster has been promoted from general manager to vice president and general manager of Aro Equipment of Canada Ltd. He joined the parent company, The Aro Equipment Corp. of Bryan, Ohio, in 1931. In 1957, Zinsmaster was named manager of procurement and production planning and held that position until his transfer to Canada later that year.

The appointment of Irving P. Magasiny as director of engineering for Schaevitz Engineering has been announced. He joined the electronics firm after more than 11 years of management, research and development engineering experience with the Philco Corp. and Tele-Dynamics, Inc. Magasiny is a graduate of the University of Pennsylvania and Drexel Institute of Technology.

Edwin A. Munschauer, Jr., has been named director of research for Niagara Machine and Tool Works. Additionally, he will continue as treasurer of the company, an office which he has held since 1955, and as a director. Munschauer has been service manager of the firm since 1941. H. Stanton Cheyney, with Niagara since 1952, will replace Munschauer as service manager.

James J. Kelly has been appointed assistant to the vice president-manufacturing of the Taylor Fibre Co. He had been plant engineer at the main plant for more than five years. Joseph J. Shanda, formerly assistant plant engineer at Precision Grinding Wheel Co., has been named to succeed Kelly. Lloyd J. Beesley has been named to the newly created post of assistant plant engineer.

Men at Work

HARRY L. WILLIAMSON has been named to the position of vice president and general manager of the Master Power Corp. He succeeds LEONARD J. ROLL, who has been made secretary and assistant treasurer. WILLIAM S. BRUCKER has been appointed engineering manager for the company, which is a subsidiary of The Black & Decker Mfg. Co.

David G. Green, left, has been appointed chief engineer of Triangle Mfg. Co. A graduate of the University of Wisconsin, he was formerly with the Transmission and Axle Div., Rockwell Standard Corp., with staff duties as tool engineer, shop foreman, plant layout engineer, plant engineer and sales engineer. Green is a member of the American Society of Tool and Manufacturing Engineers.

Henry G. Magnussen, right, for many years an official of the Lindberg Engineering Co. and the Lindberg Steel Treating Co., was recently named advisor to Niels Andrew Olsen, director, Metalworking Equipment Div., Business and Defense Services Administration, U. S. Department of Commerce. He was graduated from the University of Illinois and studied at the Illinois Institute of Technology.

JOHN M. FOX has been appointed to the newly created position of director of manufacturing of the Black & Decker Mfg. Co. THOMAS M. GRIFFITH has been appointed to the new post of director of quality control. Within the same organization, JOHN L. BENNETT has been named product development manager; ROBERT H. RILEY, JR. is technical services manager in the engineering department; and SAMUEL H. KOHLER has been named product development supervisor.

Norman R. Amberg, left, formerly works manager, has been promoted to manager of the Philadelphia headquarters plant, Yale Materials Handling Div., The Yale & Towne Mfg. Co. He has been with Yale since 1951. Thomas H. Olson, right, formerly assistant works manager, has been promoted to works manager, succeeding Amberg. He was employed by Yale in 1951.

Ampex Data Products Co. has announced the appointment of two product managers. Paul J. Weber, right, will head the Instrumentation Products Div. and James D. Bowles, left, will manage the Computer Products Div. Weber joined Ampex in 1955. He is a graduate of Cooper Institute of Technology. Bowles, a graduate of Kansas State College, has been with the company since 1954.

Durant Mfg. Co. has announced the appointment of Robert H. Rice, left, as supervisor of standard engineering. He will have charge of engineers and draftsmen working on standard product improvements, design changes, and developments. Rice formerly was with the Industrial Engineering Institute. Prior to that, he worked in special machine design for the Allen-Bradley Co.

Wayne J. Mitchell, left, succeeds Lester T. Graham as district manager for the Link-Belt Co. at Portland, Ore. Mitchell joined the firm as a designer and later became assistant to the chief engineer at Minneapolis. He was transferred to the Seattle plant in 1951 as assistant chief engineer and, in 1956, was appointed sales engineer at the Portland sales office.

NORMAN P. JOHNSON has been appointed assistant chief industrial engineer for Norton Co. He has been with the company since 1951.

RUDOLPH A. RIEDER has been named operations manager for the Data Systems Dept., Norden Div., United Aircraft Corp.

ALBERT A. E. BOCK has been appointed manager of the Prex plant of Wyman-Gordon Co. and PAUL J. WISNIEWSKI has been made sales manager.

Men at Work

Joseph Carlstein, right, has been named chief engineer of the Ketay Dept., Norden Div., United Aircraft Corp. A specialist in rotating components, Carlstein has been with Ketay since 1953. He has served in engineering capacities, most recently as supervisor of development engineering. Carlstein attended City College of New York and Brooklyn Polytechnic Institute.

The appointment of Francis P. Iapalucci, right, as plant manager of the Lake Erie Machinery Corp., Buffalo, N. Y., has been announced. The firm is a subsidiary of the Wheelabrator Corp. Iapalucci has been with the Ford Motor Co., the Baldwin-Lima-Hamilton Corp., Jackson Products and the Chrysler Corp. He attended Wayne University and the Chrysler Institute.

WILLIAM W. OLSEN has been promoted from the position of design engineer to that of assistant chief engineer, Materials Handling Div., The Yale & Towne Mfg. Co. He succeeds GEORGE H. WEAVER who has been named chief engineer of the department. In the same division, RICHARD F. BRACKIN has been promoted to assistant director of engineering. GEORGE F. QUALE is in charge of new product development.

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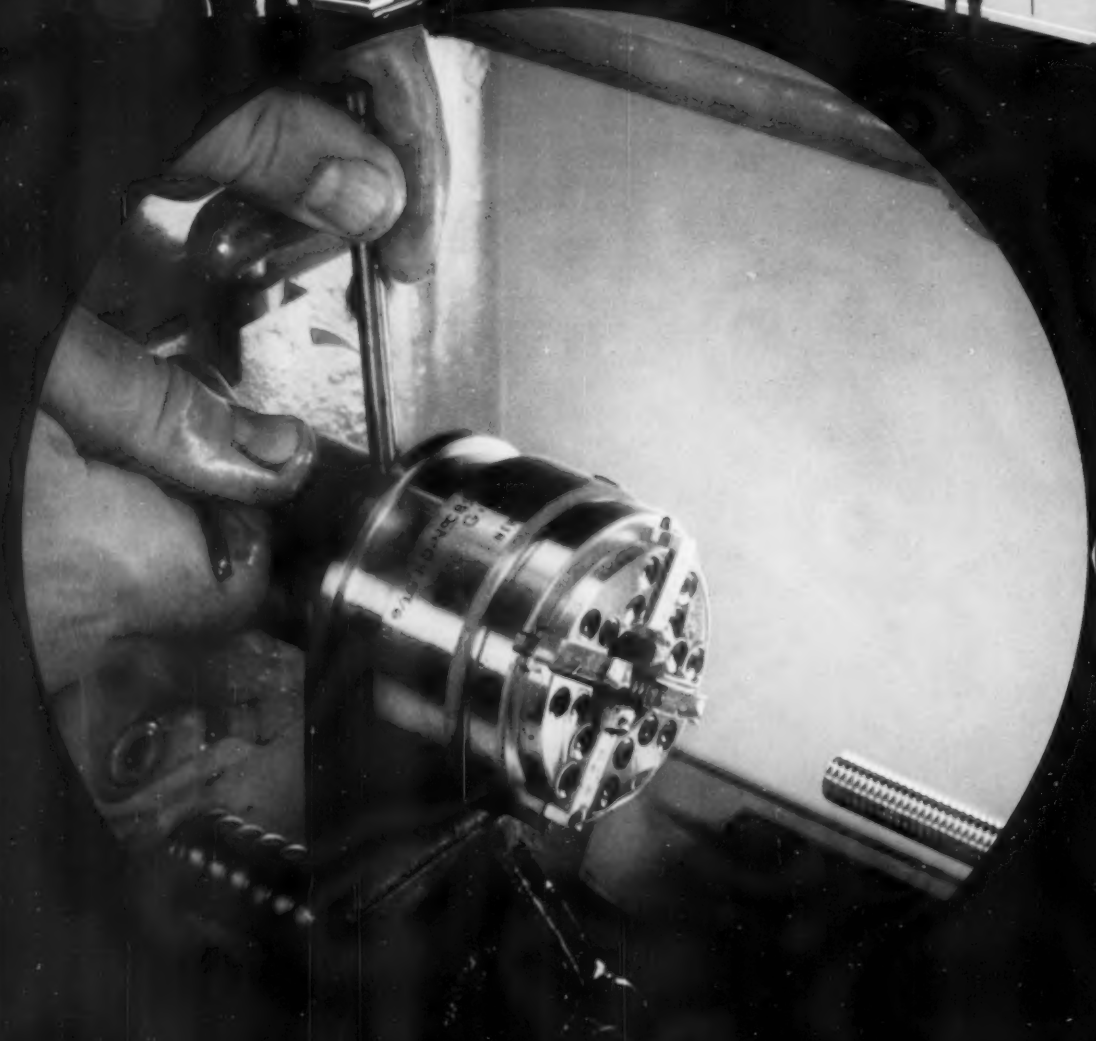

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who's meeting and where

Feb. 1-4. INSTRUMENT SOCIETY OF AMERICA. Instrument-Automation conference and exhibit, Rice Hotel and Sam Houston Coliseum, Houston, Tex.

Feb. 2-4. SOCIETY OF THE PLASTICS INDUSTRY, INC. Reinforced Plastics Div. conference, Edgewater Beach Hotel, Chicago, Ill.

Feb. 3-4. AMERICAN WELDING SOCIETY, Chicago Section, and ARMOUR RESEARCH FOUNDATION, Illinois Institute of Technology. Midwest Welding conference, Technology Center, 35 W. 33rd St., Chicago 16, Ill.

Feb. 18-20. NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS. Winter meeting, Broadview Hotel, Wichita, Kan. Information available from John T. Kane, 2029 K St., N. W., Washington 6, D. C.

Feb. 20-25. NATIONAL TOOL & DIE MANUFACTURERS ASSOCIATION. Winter board meeting, Roosevelt Hotel, New Orleans, La.

Feb. 22-26. UNIVERSITY OF KANSAS, EXTENSION CENTER. Third midwest work course on Materials Handling Analysis, Kansas City, Kan. Information available from Edward S. Avison, University of Kansas Extension Center, 39th and Rainbow Blvd., Kansas City 12, Kan.

Feb. 24-25. MALLEABLE FOUNDERS SOCIETY. Technical and Operating conference, Cleveland, Ohio. Information available from M.F.S., 781 Union Commerce Bldg., Cleveland 14, Ohio.

Feb. 25-26. EXTENSION DIV., UNIVERSITY OF WISCONSIN. Chemical and Metallurgical Engineering refresher, Wisconsin Center, Langdon and Lake Sts., Madison, Wis.

Mar. 6-9. AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Gas Turbine Power and Hydraulic conference, Rice Hotel, Houston, Tex.

Mar. 7-8. STEEL FOUNDERS' SOCIETY OF AMERICA. Annual meeting, Drake Hotel, Chicago, Ill.

Mar. 9-11. INSTRUMENT SOCIETY OF AMERICA. Temperature Measurement symposium, Deshler-Hilton Hotel, Columbus, Ohio.

TOOL ENGINEERING in Europe

By M. Kronenberg

Consulting Engineer
Cincinnati 6, Ohio

Machine Tool Controls

The development of numerical control systems in European machine tools is the subject of an article published by W. Simon in *Werkstatt und Betrieb*, Vol. 92 (11), 1959, p. 793-803, under the title: "Werkzeugmaschinen Steuerungen Theorie und Praxis einiger Weiterentwicklungen."

This article is based on studies made by the author at the sixth European machine tool show recently held in Paris. Theoretical possibilities of numerical control and the practical difficulties and limitations are considered. The author says that numerical control is still in its infancy and is applied only in special cases.

Developments center around semiautomatic boring and milling machines since with these machines the advantages can readily be judged and the increased cost can be held within economical limits. Important prerequisites mentioned by the author for reducing the cost include the production of suitable measuring systems for the length of travel, the uniformity of data supplying mechanisms and the adaptability of the machine tools to the working conditions of numerical control.

In comparison with semiautomatic single-point control (boring machines) the additional cost for constant travel control is almost prohibitive at present.

Efforts to develop numerical control systems that can be satisfactory cost-wise and also dependable in service are covered.

Gear Cutting Machines

Development of Russian gear cutting machines by the Enims-Institute at Moscow is described in the French magazine *La Machine Moderne*, Vol. 53 (606), 1959, p. 121 ff. under the title: "*Machines à Tailler les Engrenages.*"

These machines are designed for minimum downtime, short operating cycles, great precision and simplicity of operation. The greatest part of the generation of the gear teeth is accomplished by the cutting action itself. High-speed steel cutters and carbide milling cutters can be used to fullest advantage. One of the machines is equipped with a set of three mounted diamonds and an attachment for testing diamond holders.

Carbide Forming Tools

The first carbide tools were developed about 35 to 40 years ago for non-cutting methods in metal production. Cutting tools made of sintered carbides were a later development. J. van Beek reports on the more recent status of the application of carbide tools for metal-forming processes in *Technische Mitteilungen*, Vol. 52 (6), 1959, p. 229-236, under the title: "Hartmetalle in der Spanlosen Formung."

Applications such as wire drawing require high wear-resistance and toughness. Consequently a special series of carbides has been developed for these applications. The materials are known in Europe as "GT" types. Each class of GT carbides has its special field of application. The common method of preparing tools concerns the use of silicon carbide or diamond grinding wheels and boron carbides for lapping and polishing.

Newer methods make use of ultrasonic and spark erosion, although the possibility of grinding the tough GT carbides is still to be explored. GT carbides are used for wire drawing, deep drawing, pressing, cold pressing, hot pressing, and the like.

Cutting Spiral Bevel Gears

It is known from practical experience that the teeth in spiral bevel gears should not be cut to exactly the theoretical dimensions. E. Koffhaus describes a method for the machining of this type of gear in *Technische Zeitschrift fuer Praktische Metall Bearbeitung*, Vol. 53, 1959 (5), p. 163 ff, under the title "Verfahren und Maschine zum Schneiden der Verzahnung an Spiral Kegelraeder."

Best results in the operation of such gears are obtained by correction of the profile of the teeth. The author describes in detail a special setup with two wheels. The smaller wheel has an attached arm, permitting movement around the larger wheel. The free end

of the arm passes across the workpiece in the desired path, making it possible to position the gear teeth correctly so that they can be machined with a special milling cutter.

Yield Point and Chip Formation

The yield point of the work material may be taken as a criterion for chip formation according to an article by F. Eugene (Paris, France) in the Swiss magazine *Microtecnic*, Vol. 13, 1959 (3), p. 113-119. His article is entitled "Contribution to Experimental Investigation of Chip Formation and Novel Theoretical and Practical Results."

The author measured the compression of steel workpieces and ran cutting tests on the same material. He found that the chip thickness depends to a certain degree on the yield point, and his results indicate that the energy of elastic deformation of steel is higher than that of plastic deformation.

Measurement of Cutting Forces

Methods for testing and determining cutting forces are discussed in an article by H. G. Rohs in *Archiv fuer technisches Messen*, 1959, (284), p. 181 ff under the title "Messung von Schnittkraeften."

The author covers tangential, feed and radial forces. He finds that electrical measuring methods are superior to mechanical methods. The advantages of electrical methods include the small movements required in force measurement, the higher rigidity, the greater measuring range and, hence, the greater accuracy obtainable with electrical devices.

Heavy Metal Cutting

In *Technische Mitteilungen*, Vol. 52 (6), 1959, p. 236-244, J. Holzberger reports on metal-cutting processes involving heavy cuts and/or heavy workpieces, using carbide tools. The title of his article is: "Schwerzerspanung mit Hartmetall."

The author considers heavy machining jobs such as the machining of cast-steel rolls, cast-iron rolls and large blocks of metal that are difficult to machine because of the size of workpieces or because of inaccessibility of the parts to be machined. He has found that the tool geometry must be carefully watched and that the tool angles must be duplicated when the correct type of tool and insert has been selected.

technical shorts

Flame Cuts All Materials

Flame cutting of all known materials is possible with a "Powder Lance" developed by Linde Co. The lance is particularly useful in demolition work where it is used to burn through concrete. Fuel for the burner consists of a special mixture of iron and aluminum powder which is burned in a stream of high-purity oxygen. Heat from the reaction is intense enough to melt any ferrous or nonferrous materials.

* * *

Tap Cartridge Removes Chips

Wax pellet tap cartridges that eliminate chip problems encountered in blind hole tapping operations have been developed by the Tap Cartridge Co., Cincinnati, Ohio.

In the tapping operation, the cartridge is dropped into the drilled hole. As the tap advances into the hole, a solid flow of wax carries the chips along and out the flutes. Chips left at the bottom of the hole are embedded in that portion of the cartridge still in the flutes of the tap and are withdrawn with the tap. Use of the cartridge permits the tap to touch the bottom of the hole with no chip interference and it is not necessary to clean the tap before repeating the operation.

* * *

International Standards

A number of international standards for machine tools are being considered by the member nations of the International Organization for Standardization (ISO). Two of these standards covering lathe tool posts and speeds and feeds for machine tools have been approved by ISO Recommendations. Four more proposals being circulated for approval deal with 5 percent taper for tool shanks (Morse, Metric, and Browne and Sharpe tapers), lathe centers, 7/24 tapers, and symbols appearing on the controls of machines. The last subject is aimed at substituting word descriptions with symbols which can be understood in any country where the machine is used.

Sintered and Forged Tungsten

A new process of producing large tungsten ingots weighing up to 200 lb has been developed by Dr. Paul Schwarzkopf, President of Schwarzkopf Development Corporation, 595 Madison Ave., New York, N. Y., and of the Metallwerk Plansee in Reutte, Tyrol, Austria. By means of the new process, large blocks of approximately eight in. diam and a height of eight in. are formed from tungsten powder in large capacity presses. The blocks are sintered indirectly in high-temperature furnaces and then forged.

Equipment suitable for sintering and forging for pure tungsten and tungsten alloys was developed in the Austrian plant. Important applications for tungsten and tungsten alloys are parts exposed to very high temperatures, corrosive attack and radiation.

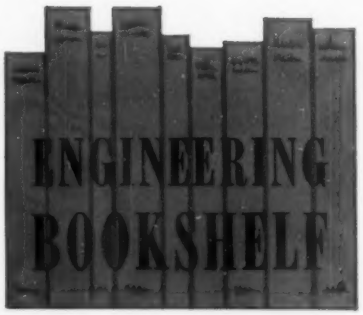
* * *

New Plastic and Ceramics Material

Material with exceptional high heat-resistant properties has been developed by the Cordo Chemical Corp., manufacturer of plastic preimpregnated materials. Called Resin Bonded Quartz Sheet, it is a combination of reinforced plastics and ceramics. Both of these materials have been used with limited success in the rocket and missile fields, but neither material in itself represents the complete answer to the extremes of temperature encountered in these applications. In combination the materials have distinct advantages over either plastics or ceramics alone.

The manufacturer recommends use of this material as a facing on a laminate of standard Pyropreg reinforced plastic. Resin Bonded Quartz Sheet is not a structural material and in the cured form has physical properties comparable to the resin itself.

Special properties of exceptionally low ablation loss under extreme conditions are attributable in large part to the use of quartz. Fused quartz particles used in Resin Bonded Quartz Sheet have an extremely low coefficient of thermal expansion. Melting point of the fused quartz is in excess of 3100 F.



METAL CUTTING TOOL HANDBOOK—*Published by Metal Cutting Tool Institute, 405 Lexington Ave., New York 17, N. Y. Price $7.50. 750 pages.*

This revised edition of the Handbook presents the latest nomenclature for twist drills, reamers, counterbores, taps, dies, milling cutters, hobs, gear shaper cutters, gear shaving cutters, and broaches. In each section there is extensive information in the design, proper application and the maintenance procedures of the tools described. The use of carbide in broaches, drills, reamers, and milling cutters is included. This is followed by tables of dimensions and tolerances of standard size, styles and types of tools.

The engineering data section at the end of the book contains general tables, formulae, and other data commonly used by engineers in the metalcutting industries.

STATISTICAL QUALITY CONTROL—*By D. H. W. Allan. Published by Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y. Price $3.50. 129 pages.*

Part of the Management Science Series, this brief little book presents statistically quality control to management to help determine its value to their operation. The subject is treated competently in broad and nonmathematical terms. Since it is both brief and easy to read, the book is a handy tool for anyone who wishes to learn something about the objectives, concepts, and methods of statistical quality control.

ENGINEERING MANUFACTURING METHODS, SECOND EDITION.—*By Gilbert S. Schaller. Published by McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N. Y. Price $9.50. 682 pages.*

Greatly revised from the first edition which was published in 1953, this new text demonstrates the effect technological change on the manufacturing engineer's job. As the battery of methods, tools, and techniques at the disposal of the manufacturing engineer is increased, he can accomplish more. However, his job becomes more complex, and he is required to learn more. Prof.

Schaller's book will provide a valuable assist to tool and manufacturing engineers.

The text deals with five areas which must be considered when selecting a method of manufacturing: materials, foundry, shaping and treating, machining and welding. The second edition exceeds the first edition by about 70 pages and includes new information on automation, nucleonics, and a full new chapter on numerical control.

TOOL ENGINEERING — *By S. E. Rusinoff. Published by the American Technical Society, 848 E. 58th St., Chicago 37, Ill. Price $6.75. 326 pages.*

Starting from the premise that tool engineering grew originally from the immediate experience of those involved in mass production, and that the need exists to synthesize and crystallize such empirical knowledge into more analytical and scientific knowledge, Prof. Rusinoff makes this book his contribution to the newest of engineering sciences—tool engineering.

He breaks the tool engineer's job into seven main parts: consulting with designers; studying costs; production planning; operation analysis; equipment selection; equipment improvement; and developing operations.

The information is presented in a simple and descriptive manner; it should be a useful text for students and for anyone who must know more about tool engineering.

VALUE ENGINEERING 1959. *Proceedings of the EIA Conference on Value Engineering. Published by Engineering Publishers, P. O. Box 2, Elizabeth, New Jersey. Price $6.00. 165 pages.*

Value engineering, or value analysis as it is frequently called, is an aspect of manufacturing engineering whose success is attracting wide attention. It has been defined as "An organized approach to the problem of getting more for our money."

Several important electronic equipment manufacturers adopted its principles with results beyond even optimistic expectations. Recorded here are the complete versions of all the technical papers presented at the Electronic Industries Association Conference on Value Engineering. The first comprehensive industry conference on the subject was held at the University of Pennsylvania, and covers basic concepts, philosophies, techniques, and applications.

Though illustrated by electronic and military hardware examples, the principles used have wide application. Topics include: utilization of resources, value assurance vs. improvement, and relationship of value engineering to standardization.

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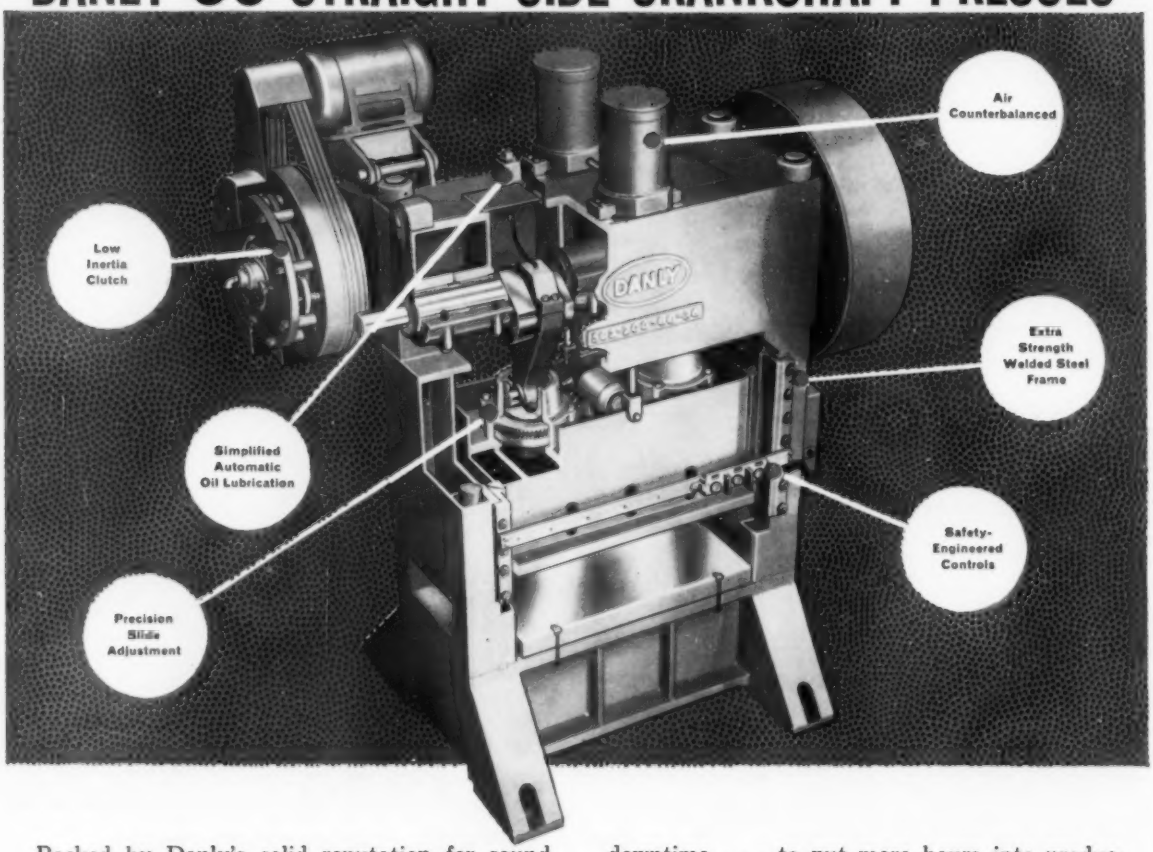

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Tech Digests

Our Growing Dependence upon Science for Survival

The tasks of keeping the complex machinery of industrial society functioning, of producing raw materials from the leanest of earth substances, of providing enough energy and power, of producing enough food for the rapidly-increasing numbers of mouths, of decreasing the rate of population growth—these tasks will necessitate our accumulating knowledge in the decades ahead at a rate which is far greater than our rate of accumulation today. Whether we like it or not, we have passed a major point-or no-return and have become as dependent upon our science, technology and industry for the well-being of our civilization as we are dependent upon food for the well-being of our bodies.

It is obvious that the problems of survival which confront us today are complex and that those which will confront us tomorrow will be even more difficult to solve. These problems cannot be solved by narrow specialists or by robots, nor can be solved by persons who live by platitudes and slogans. Indeed, they can only be solved by persons who possess a broad view of the world in which we live and of man's place within it—in short, by men and women who are truly well-educated, far above the level which is accepted today as perfection.

We have to face the fact that we are simply not sufficiently well-educated to survive in our modern world—that the savage in the jungle was far better equipped to survive in his world than we are in ours. The savage who is not familiar with his tools and weapons and who does not understand the habits of the plants and animals about him cannot survive for long. Similarly, we who live in the complex environment of industrial civilization must understand that civilization, the forces which operate upon it and the dangers which threaten it.

Intimately connected with the problem of education, particularly at the higher levels, is the problem of accumulating new knowledge—of research. The tasks of keeping the complex machinery of industrial society functioning, of producing raw materials from the leanest of earth-substances, of providing enough energy and power, of producing whether or not the area in which a given scientist is working is likely to yield important or significant results.

The pursuit of basic research requires an atmosphere of freedom within which the individual scientist can operate. But as time has passed, although our number of scientists have increased rapidly, the constraints placed upon them by our society have also increased. One of the more important of these constraints involves the sources of funds.

Few universities or research institutes are sufficiently well-endowed to pay for any really large fraction of the research which is undertaken behind their walls. They must look for the support of their laboratories to private donors, to foundations, to industry and to the Government. These groups have the power of determining whether a given laboratory or a given research project will flourish or starve.

Based on an address by Dr. Harrison Brown, California Institute of Technology, before the 10th Thomas A. Edison Foundation Inst., New York 26, N. Y.

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Developments in Welding Magnesium

Magnesium welding wire stored for as long as seven years can now be used with performance previously obtainable only with freshly prepared wires. Prior to this development, such heavily oxidized welding wire proved unsatisfactory because the current could not be transferred easily and uniformly to the wire. The solution to this problem was obtained by a new contact tube which was designed for gas-shielded metal-arc welding equipment.

The new contact tube that was designed to obtain better electrical contact has a series of interior wires which are fastened at the inlet end and float at the outlet end. The wire inserts from the internal hole through the major portion of the tube and are free to move under the forces applied by the welding wire. This contact tube provides more area of mechanical contact with the welding wire than the standard straight bore tube.

When a wire passes through the wire insert contact tube, points of electrical contact are made at more than one point near the exit end because the welding wire can nestle between the insert wires. Since the insert wires are free to move under the forces of wire cast or electromagnetic fields, a wiping action on the welding points of electrical contact and wiping action produces a stable welding arc even with heavily oxidized magnesium welding wire.

A commercial process to lower the melting rate of magnesium welding wire has not been developed, but experiments show that a lowering is possible. Techniques have been developed for lowering the melting rate of aluminum and steel by using liquid or dust coatings of emissive agents on the welding wire surface. This development necessarily is a straight polarity process since the action of the emissive agents is restricted to the cathode or negative terminal of the arc. Experiments with steel and aluminum welding wire have been reported. Since the same results have been shown to be valid for magnesium, the reported data and effects can be extended to magnesium.

Based on a paper by Craig Sibley, Air Reduction Co., presented at the 15th Annual Convention of The Magnesium Association, 122 East 42nd St., New York 17, N. Y.

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Critical Velocity of Stick-Slip Sliding

Extent of the critical velocity of stick-slip is dependent on different parameters. Since stick-slip occurs at a velocity lower than the critical, it is necessary in practice to have a critical velocity of the system as low as possible. This can be achieved by narrowing down the difference between the static and kinetic forces of friction, increasing

stiffness-inertia ratio, and by increasing damping in the system.

The difference between static and kinetic coefficients of friction can be reduced considerably by replacing sliding friction by rolling friction or by using lubricants with special polar additives. Roller guides are successfully applied in machine tools with this object. Moreover by reducing friction in this manner, the requirement for the provision of high stiffness and power in the drive is reduced. A high stiffness in the drive may be achieved, for example, by the use of unidirectional drive which must be located toward the end of kinematic scheme, as near to the driven body as possible.

Increase of damping in the sliding system may help to lower the critical velocity considerably. Damping can be augmented externally by the use of dampers, or by employing grease lubrication in place of fluid lubricants. On the other hand, damping may be increased by the application of special materials with high internal friction as, for instance, the use of plastics or cast iron in place of other metals.

Also a study of the influence of the fluctuations in the drive velocity of the application of a forced vibration on the sliding system reveals that resonance vibrations enhance the stick-slip effect while high-frequency vibrations may reduce the stick-slip effect.

Based on ASME Paper No. 59-A-146 by B. R. Singh, Britannia Engineering Co., Ltd. American Society of Mechanical Engineers, 29 West 39th St., New York 18, N. Y.

TO REQUEST COMPLETE PAPERS WRITE TO THE ADDRESS AND ORGANIZATION INDICATED AT THE END OF EACH ABSTRACT

Application of Materials to High-Temperature Service in Rocket Engines

In considering materials for this application in rocket engines, none of the common metals or alloys is capable of sustaining such temperatures for a time period of more than several seconds and still retain properties of engineering value. There are a variety of nonmetallic refractory coatings and ceramic bodies which may be used in special applications. For the most part, however, vibration, thermal shock, and erosion due to combustion excludes the nonmetallic materials and presents the designer with the problem of utilizing commercial materials and processes.

The designer must be cognizant of the problems of quality control and manufacturing just as quality control and manufacturing must also take cognizance of considerations other than their own. In this sense, the application of materials to high-temperature service is no different than low-temperature problems, vibration, or similar stringent operating conditions which are encountered in many phases of engineering.

Based on SAE Paper No. 98V by R. P. Frohmberg, Rocketdyne Div., North American Aviation, Inc. Complete paper available from Society of Automotive Engineers, Inc., 485 Lexington Ave., New York 17, N. Y.

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Determination of Cutter Trajectories for Contoured Turbine Buckets

The advent of numerically controlled machine-tool systems introduces the serious problem of suitably employing them for part fabrication. To numerically contour the complex surface of a large turbine bucket with this type of machining system, it is necessary to determine the geometrical constraints on the motion of the cutter, which will sweep out the desired part surface as an envelope of the cutter surface. A definition of the turbine-bucket surface can be given in terms of unequally spaced cross sections along the length of the part, and an interpolating procedure is employed to define the entire surface with properly faired transitions between the specified cross sections. Procedures have been used to program an IBM 704 computer for the preparation of digital control tapes, which instruct the motions of the machining system.

Based on ASME Paper No. 59-A-111, by R. G. DeBiase, General Electric Co., American Society of Mechanical Engineers, 29 West 39th St., New York 18, N. Y.

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Shock and Vibration Tests

Shock and vibration tests are usually established on the basis of the maximum intensities of shock and vibration that occur in the field and for locations at which an equipment to be tested may probably be used. For equipment that is not negligibly light compared with the foundation on which it is mounted, such a procedure leads to overconservative and difficult-to-perform tests. This is caused by consistent less-than-maximum intensity of excitation which oc-

curs at frequencies for which the equipment has large values of mechanical impedance. It is at these frequencies that damage to the equipment is most likely to occur. If tests were performed on machines such that the impedence of the mounting platform were as great as the field mounting foundation, then a more realistic and easier-to-perform test would result if no compensation were made in order to eliminate dips in the excitation spectra caused at frequencies of large equipment impedence. It is suggested that such compensation be not generally used for such tests.

Based on SAE Paper No. 100X by Irwin Vigness, U.S. Naval Research Lab. Society of Automotive Engineers, 485 Lexington Ave., New York 17, N. Y.

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Applications of Rare Earths to Ferrous and Nonferrous Alloys

Improvements in steel alloys made by adding yttrium, a rare metal, may hold the key to heat-resistant metals needed in atomic flight and the space age. Yttrium and in some cases other rare metals have an extremely beneficial effect on workability, grain refinement and resistance to recrystallization at elevated temperatures of various steel alloys. Most extraordinary effect of the addition of yttrium is the improvement in high-temperature oxidation resistance of iron-base alloys containing chromium. An outstanding example is AISI type 446 stainless steel, containing 25 percent chromium which is oxidation-resistant to 2000 F. A variation of this alloy, which provides even greater oxidation resistance includes a fourth element, either aluminum or thorium.

Based on a paper presented to ASM Atomic Energy Commission Symposium, by J. F. Collins, V. P. Calkins and J. A. McGurty, General Electric Co. Complete paper available from American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio.

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Design for Reliability

Our missiles of today are bringing us closer to the space age, but we must have more reliable systems than we do today to reach this age. Engineers are envisioning and planning larger and more intricate systems to put us into outer space, but are these systems to be relied upon? Manned aircraft systems of the past generally accepted the failure of equipment in mechanical systems. It was said that equipment is bound to fail now and then so you may as well

accept it. However, with the advent of missiles where mechanical failures are generally catastrophic, a new philosophy has been developing, for the engineer, designer, and all those contributing large and small to a system.

It is in design where the fundamental reliability situation is determined. This is the crux of our problems and here the solutions can be made. The following "Ten Commandments for Design Reliability" should be referred to from time to time during all phases of design, and even during the maintenance period a review of the basic design criteria should be made.

1. Provide for absolute mechanical simplicity
2. There shall be no component in the system which by any stretch of the imagination or ingenuity can be avoided
3. Simple mechanical mechanisms are more reliable than complex ones
4. Functional equipment which is already in quantity production is more reliable than equipment developed and built especially for the system
5. The system shall be designed to have liberal performance margins rather than to be just adequate
6. The equipment design specification shall specify the type of air-weapon system the part is to be used for, and that reliability is the major design requirement
7. The system shall provide for checking every vital function of every component by the System Inspection Test after assembly is complete
8. Provide for absolute minimum vital-complex functions
9. Provide for absolute minimum vital human functions
10. Levels of reliability which have been accepted as inevitable for manned aircraft systems and components are generally inadequate for complex missiles.

Based on SAE Paper No. 101U by B. Bradford Richardson, Norair Div., Northrup Corp. Society of Automotive Engineers, Inc., 485 Lexington Ave., New York 17, N. Y.

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Gear-Position Error Control

The angular position error in a gear is a criterion which cannot be governed completely by and equated to total composite error. This is being recognized by an increasing number of gear designers and producers. Significantly, during

the past year, the AGMA issued a notice for affixing to Standard 236.04 which calls attention to failure of the composite check to control position error.

Although there is some interdependency between position error and total composite error only specific cases can be assumed equivalent. To design and specify precision gears properly, it is necessary to specify a control on maximum position error. This is a new concept relative to the present universal procedure of attempting to obtain this control by use of TCE specification. However, the faulty present procedure has the virtue of low cost and rapidity in fabrication and inspection. Therefore, it will continue to serve as a suitable control on all gearing except that requiring precise control. The significant point is the realization of this situation and the ability to decide properly when to use each type of specification. Thus, this adds a further decision and responsibility to the activity of the precision-gear engineer.

Based on ASME Paper No. 59-A-21 by George W. Michalec, General Precision Laboratory, Inc., American Society of Mechanical Engineers, 29 West 39th St., New York 18, N. Y.

TO REQUEST COMPLETE PAPERS WRITE TO THE ADDRESS AND ORGANIZATION INDICATED AT THE END OF EACH ABSTRACT

Engineering Education

We are in the midst of an era of scientific development of great proportions. The impact of these developments is influencing the lives of all the people of the world. In engineering education, the impact has created a sudden and profound shift in that much less time and effort is being given to teaching the skills; new emphasis is being given to mathematics, chemistry and physics.

In the undergraduate teaching of materials, there is little uniformity in course content and in methods of teaching between institutions—likewise, the same is true in comparing the course content of the various engineering curricula in a given institution, although there are noteworthy exceptions.

One of the great problems facing engineering education, industrial development, and even our national defense is our inability to attract a higher percentage of our engineering graduates to pursue graduate programs in engineering or in science.

tech digests

Research and development at the graduate level in departments of physics, chemistry and in engineering itself should be expanded wherever possible and additional effort should be expended to obtain additional funds to further this kind of activity and especially in developing interest on the part of young graduate engineers who are well qualified to pursue graduate programs in materials and related areas, rather than to accept industrial employment without the benefit of the graduate program.

ASTM is keenly aware of these problems and is preparing to offer fellowships for graduate students in the materials area in the near future.

The new Division of Materials Sciences should go a long way in collecting and publishing fundamental information of materials, obtained from the "across the board" disciplines represented in the Society, as well as from the outside.

Based on Introduction to Joint ASEE-ASTM Symposium on Impact of the Developments in Materials Sciences on Engineering Education, by K. B. Woods, President, ASTM. Complete paper available from American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.

TO REQUEST COMPLETE PAPERS WRITE TO THE ADDRESS AND ORGANIZATION INDICATED AT THE END OF EACH ABSTRACT

Trends in Fatigue Analysis of Aircraft Fasteners

Recent changes in flight vehicle mission, speed, range, and service environments have greatly altered the fastener fatigue concept. The range of fatigue encountered in a sub-sonic, piston-driven airplane could be quite successfully simulated by the standard NAS-1069 fatigue test. But this test cannot approach simulation of the complex dynamic loads created by a rocket powered vehicle screaming through the atmosphere at thousands of feet per second. Among the factors which must be considered in evaluating future fasteners are:

New materials, alloys and composites

Thermal shock resulting from alternating exposures to extreme cold and super heat

Acoustic and aerodynamic loads

Gross effects of nuclear radiation

Protective coatings and how these may alter the dynamic integrity of fasteners

One frequently discussed design trend is to reduce the number of fasteners required by increasing the number of brazed joints and weldments. This might reduce the number of fastener problems but would certainly multiply welding problems by many fold.

Total elimination of fasteners in the foreseeable future is most unlikely. Upgrading of fastener quality and reliability, particularly for critical application, will become increasingly urgent. The optimum means of predicting fastener behavior in service is to simulate the anticipated dynamic conditions. If one were to simulate the many possible dynamic conditions simultaneously, a machine of impractical size, complexity, and cost would be required. At the risk of being unable to discover inter-relating effects of aerodynamic loads, acoustic loads, heat, etc., future dynamic fastener testing will probably be conducted by imposing dynamic conditions on a 'one-or-two at a time' basis. Elevated temperature fatigue tests are practical; however, the addition of such dynamic variables as acoustic loads or thermal shock would be very difficult.

TO REQUEST COMPLETE PAPERS WRITE TO THE ADDRESS AND ORGANIZATION INDICATED AT THE END OF EACH ABSTRACT

New fastener materials will probably play an increasingly important role; but before they can be considered reliable, a thorough understanding of their dynamic properties will be necessary. Refractory metals and alloys are considered as materials for special-purpose fasteners. In fact, molybdenum alloy fasteners have already been made and tested by Voi-Shan Manufacturing Company, Inc. Beryllium, sometimes referred to as 'the space metal' has also been fabricated into fasteners. Fig. 12 shows two of the first hot-headed beryllium fasteners ever produced; they too, were made by Voi-Shan. Parts such as these are now being considered for application in both space vehicles and airborne nuclear reactors.

It is of utmost importance that future flight vehicle fasteners be constantly upgraded by fastener producers. After all, airborne weapons are no more reliable than the fasteners with which they are held together.

Based on SAE Paper No. 108T by J. L. Chinn, Norair Div., Northrup Corp., Society of Automotive Engineers, 485 Lexington Ave., New York 17, N. Y.

Factors Affecting the Efficiency of Resin-Bonded Diamond Grinding Wheels

The results of more than 600 tests involving 145 resin bonded diamond grinding wheels conducted at the Diamond Research Laboratory during the past year, have indicated that the normal Laboratory methods of testing these wheels give very misleading results unless special precautions are taken. Factors which lead to errors are variations in the internal hardness of the carbide test pieces and variations in the wheels themselves. The use of micrometers to measure wheel wear also leads to inaccuracies. To overcome the errors introduced by the variations in the hardness of the carbide test pieces a new method of testing has been developed by the Diamond Research Laboratory, in which wheel wear is measured with a toolmaker's microscope.

It has also been found that the hardness of the resin from which the wheel is made can have a marked effect on the comparative grinding results of natural and synthetic grit when the particles of the former material have the conventional blocky shape generally employed.

The blocky particles of grit which, as far as possible, should be avoided in resin wheels, since they break too easily out of the wheel, find their best application in metal bonded wheels and in saws. Operating pressures with metal bonded wheels and saws, due to the tough nature of the bond, are in general, much higher than in resin bonded wheels, and since blocky particles of natural diamond can be firmly held in metal bonds, full use can be made of their strength and resistance to abrasion.

It is clearly indicated that the natural grit generally used in resin bonded grinding wheels can be improved by selection of particle shape and condition. To achieve the best result, grit intended for resin bonded wheels should have the blocky particles removed and should have an irregular or rough surface to be more satisfactorily held by the resin. The particles should fragment relatively easily so that the bulk of the particle will remain embedded in the resin. The efficiency of wheels employing this type of grit will be up to 40 percent higher than with wheels containing the conventional type of natural grit.

Based on a paper by R. G. Weavind, Diamond Research Laboratory presented at an Annual Meeting of Industrial Diamond Assoc. of America, 587A Turnpike, Pompton Plains, N. J.

Specially made for Watervliet Arsenal, this Boring Bar of Kennametal* is believed to be the largest ever made from tungsten carbide. Over the 64½-inch length, the diameter tapers from 5 to 3½ inches.
*Trademark

KENNAMETAL
makes boring bars for ANY size machining job

Machining large gun tubes has been a problem for years. At the Watervliet Arsenal, the 40-inch powder chamber in 120mm M58 type tubes presented an extremely difficult job due to the length-to-diameter ratio of 12:1. After steel boring bars proved unsuccessful, costly high-speed contour reamers were used but required 9.2 hours to semifinish the chamber for grinding. In addition, maintenance of the reamers cost $121 per unit.

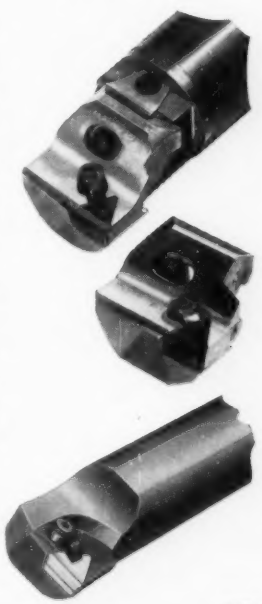
With the Kennametal bar shown at left, machining time has been reduced to four hours. Due to its high Y.M.E. (3:1 ratio over steel) deflection and vibration were practically eliminated. Extreme accuracy and consistently fine surface finish is provided despite the 43.5-inch overhang, and a .200-inch depth of cut. After fully repaying its original cost, the Kennametal bar saves $10,700 per 100 pieces over the reaming method.

Kennametal Boring Bars can save YOU money, too

On small or medium size boring jobs, new adjustable-head Kennametal K-Bars (right) provide the same accuracy and fine finish due to their high resistance to deflection and chatter. Standard K-Bars are available in seven diameters from 1 to 2½ inches—with two or three adjustable heads—for high precision work. This design brings simple, accurate adjustment . . . without sacrificing strength and rigidity.

Standard Kendex Boring Bars (lower right) are stocked in seven diameters. Made from heat treated alloy steel, these bars are ideal for less severe applications. They are fitted with standard Kendex triangular or square inserts, with solid Kennametal chipbreakers and shims for positive seating.

Get more information on Kennametal Boring Bars . . . for ANY size machining job. Call your Kennametal Representative, or write . . . KENNAMETAL INC., Latrobe, Pa.



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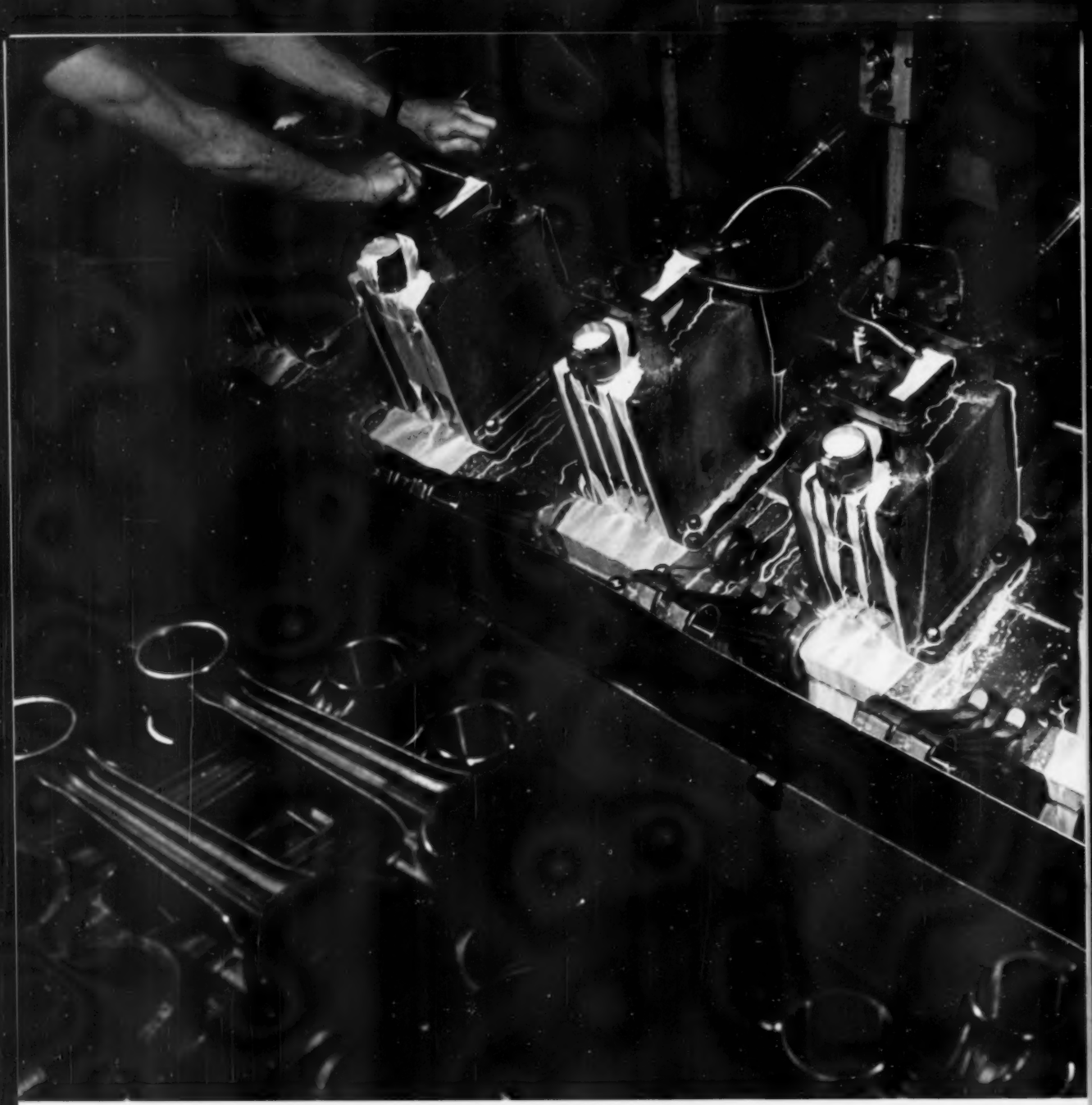
INDUSTRY AND
KENNAMETAL
...Partners in Progress



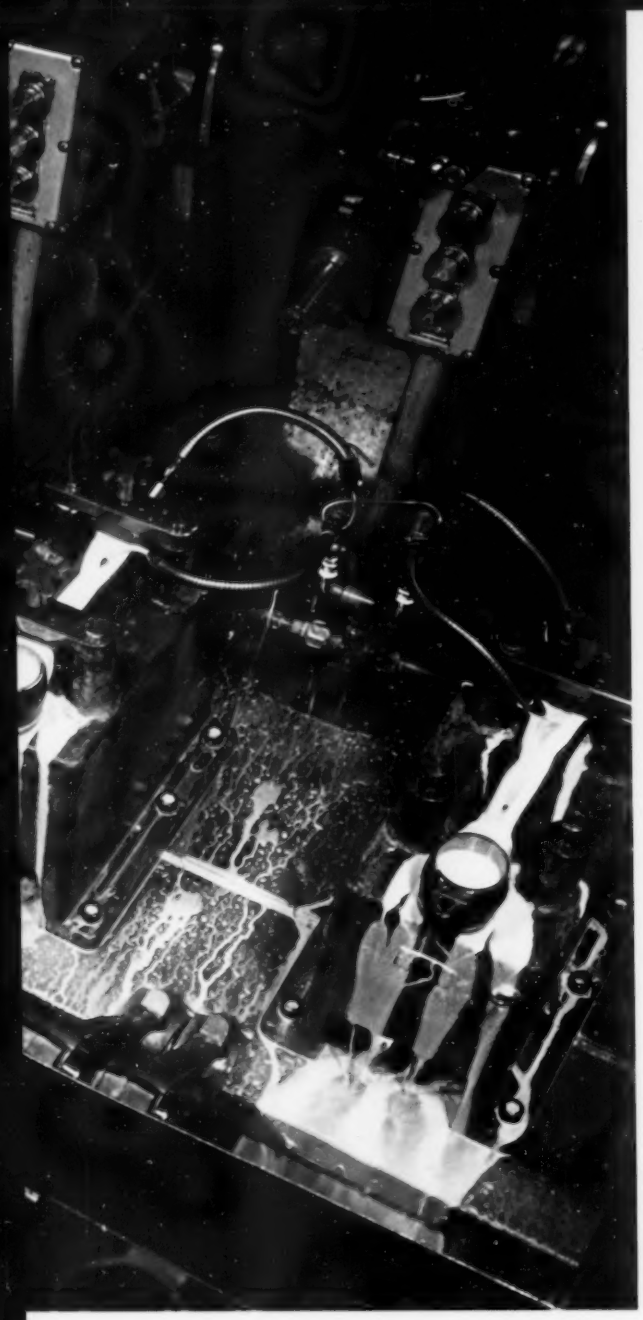
Cummins Engine Company does efficient machining, and

GULF MAKES THINGS

Leave it to the makers of world-famed Cummins Diesel engines to make every possible use of a good product! Cummins uses Gulfcut Soluble Oil not only to obtain superior cutting and longer tool life, but also to get the benefit of its rustproofing properties.

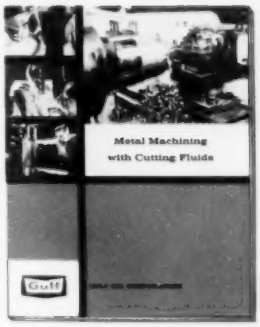
Cummins Foreman James L. Hoppus tells of drilling 12″ deep, ¼″ diameter holes through steel connecting rods. Gulfcut Soluble Oil keeps tool and work so cool, the drilling area so clean of chips, that this tough drilling job is often done in one pass without drill retraction.

For protection against rust, Cummins uses Gulfcut Soluble in two major applications. Sensitive fuel injector parts acquire a rust preventive film when dipped in the heated emulsion. And,



John Hedges, right, Supervisor of Tool Control, Cummins Engine Company, points out fuel injector protected by Gulfcut Soluble Oil to M. S. Ringo, Gulf Sales Engineer.

NEW 116-PAGE MANUAL tells all about cutting oil selection and usage. Send for your free copy of "Metal Machining with Cutting Fluids."



Six-station Avey Drill Press deep-drilling connecting rods with Gulfcut Soluble Oil at Cummins Engine Company, Inc., Columbus, Indiana.

effective rustproofing with Gulfcut® Soluble Oil . . .

RUN BETTER!

come summertime, Cummins adds five gallons of emulsion to the cooling systems of their engines to rustproof them until the winter season.

For every machining operation there is a Gulfcut oil to meet your requirements. A Gulf Sales Engineer can advise you on the proper type to help you improve machining performance. Just call the nearest Gulf office.

GULF OIL CORPORATION
Dept. DM, Gulf Bldg., Pittsburgh 30, Pa.

☐ Send literature on Gulfcut oils.
☐ Send copy of "Metal Machining with Cutting Fluids."

Name_____
Title_____
Company_____
Address_____
City_____ Zone____ State_____

SP-9728

Why did these chips

cost more than these?

LOOK TO INGERSOLL FOR THE ANSWER

—because the cutter used to produce the more costly chips was not the right one for the work or for the machine on which it was used. It was a good cutter but not as good as it could have been. It's as simple as that.

The lower cost chips were produced by a cutter recommended by Ingersoll Cutter engineers. Their recommendation was based on an analysis of the work, the job requirements and the machine.

There are many ways that the cost of chips can be reduced. Why not let an Ingersoll representative make a preliminary survey? It will cost you nothing and may lead to important savings. Ask to have a representative call, or write for booklet "Ways to reduce the cost of chips." Address Dept. K-68.

THE INGERSOLL MILLING MACHINE COMPANY CUTTER DIVISION ROCKFORD, ILLINOIS

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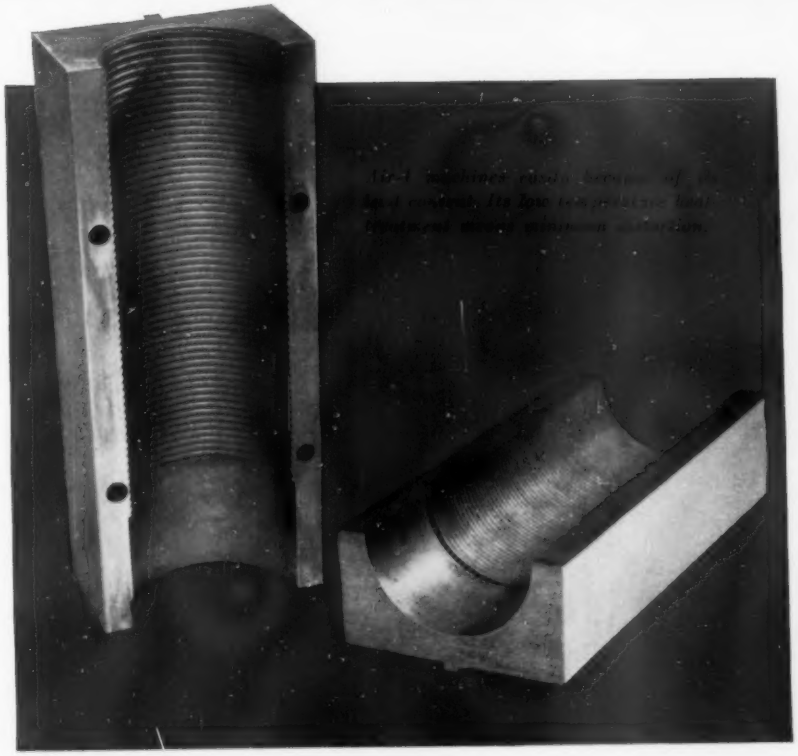
Tool Steel Topics

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.



Another Report on AIR-4 TOOL STEEL:

"These clamping bars machined like a dream, and distortion was kept to a minimum."

The clamping bars above, of Bethlehem Air-4 tool steel, were made by Miller Tool and Die Company, Gloucester, N.J. John J. Nesbitt, Inc., Philadelphia, uses them for holding and expanding metal tubing. The dies, hardened to Rockwell C 57-58, were each machined from a piece of Air-4 1¾ in. thick, 3½ in. wide, and about 8 in. long. The over-all tolerances were plus or minus .002 in.

Easy to Machine, Low Distortion

According to our local tool steel distributor, Horace T. Potts Company, the customer reported that the machinability was "like a dream." And they were also delighted with the lack of distortion during heat-treatment—"best distortion-resisting grade we've ever used for this type of die."

Hardens in Air at 1550F

Air-4 is our new free-machining medium-alloy tool steel. It hardens in air at low temperature—about 1550F. It has excellent free-machining characteristics because of its addition of lead. Air-4 also has superior wear-resistance, high toughness, and deep-hardening properties, making it ideal for long tool life.

If you would like to have additional information about Air-4, get in touch with your Bethlehem tool steel distributor. Better still, order a trial bar and put it to work in your shop.

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BETHLEHEM TOOL STEEL ENGINEER SAYS:

The Direction of Grinding Marks Affects the Life of Tools

It might be well to take a good look at your tool-grinding practice, because it has been proved time and again that the direction of grinding marks has a direct bearing upon tool life. This is especially true with such tools as deep-drawing dies, and punches that have a moving contact with metals under high pressures.

No matter how fine or smooth the surface finish of ground tools may appear to be, don't be fooled—it actually has a saw-tooth contour. Material which moves parallel to the grinding marks shows much less tendency to "pick up," or adhere, than material moving across the grinding marks. But this "pick up" of material can't be permitted on such tools as drawing dies, where it's advantageous to grind in the same direction as the material moves. On some types of tools this kind of grinding is difficult, but the longer tool life justifies the effort. Punches which are ground longitudinally last much longer than those ground circumferentially, the most common method. Here also, longitudinal grinding is inconvenient, but worthwhile.

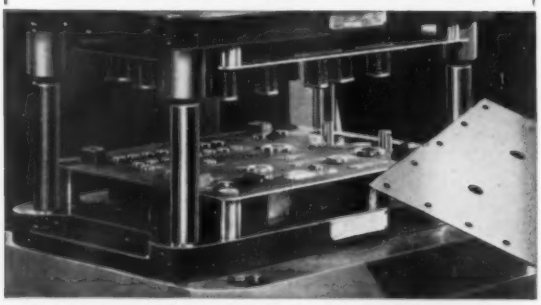
Although the direction of grinding on tools isn't given much thought in the average shop, it is often a big factor in getting the best possible tool life.

Send for TOOL STEEL LITERATURE

If you would like to receive booklets on Bethlehem tool steels, indicate your choice on this coupon, and mail to Room 1045, Publications Department, Bethlehem Steel Company, Bethlehem, Pa.

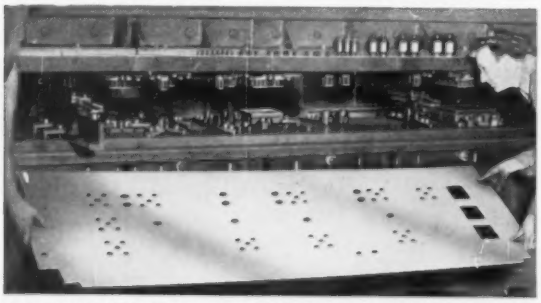
- ☐ Hot Work
- ☐ High Speed
- ☐ Carbon and Carbon-Vanadium
- ☐ Shock Resisting
- ☐ Hollow Bar
- ☐ Oil and Air Hardening
- ☐ Special Purpose
- ☐ Lehigh H (High Carbon, High Chrome)
- ☐ Bearcat
- ☐ Tool Steel Selector

OVER 2700 PLANTS
are saving money with
WHISTLER DIES



MAGNETIC PERFORATING DIES

All parts reusable and interchangeable. Punches and dies stocked in .001" increments from .100" thru .500" dia. Larger sizes available.



ADJUSTABLE PERFORATING DIES

All parts reusable and interchangeable. Punches and dies stocked in .001" increments from .100" thru .500" dia. Larger sizes available.

manufacturer of all types of
CUSTOM DIES for over 40 years

See Us in Booth 1339, ASTE Show

S. B. WHISTLER & SONS, INC.
744 Military Rd., Buffalo 23, N. Y.

Mail the following: ☐ Magna-Die Catalog ☐ Adjustable Die Catalog
☐ More information on custom die work

NAME _____ TITLE _____

COMPANY _____

STREET _____

CITY _____ ZONE _____ STATE _____

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DYKEM STEEL BLUE®

Stops Losses making Dies and Templates

Popular package is 8-oz. can fitted with Bakelite cap holding soft-hair brush for applying right at bench; metal surface ready for layout in a few minutes. The dark blue background makes the scribed lines show up in sharp relief, prevents metal glare. Increases efficiency and accuracy.

Write for sample on company letterhead

THE DYKEM COMPANY
2303D North 11th St. • St. Louis 6, Mo.

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ACCURACY .0002 T.I.R.

.0002 T.I.R. or less at Spindle Nose, .0005 T.I.R. or less on Test Arbor six inches from Spindle Nose

SPINDLE SPEEDS 150 and 250 RPM Other Spindle Speed Pulleys Available

MODEL B943 MOTOR DRIVEN WORK HEAD

No. 11 B & S Tapered Spindle Standard Equipment. No. 12 B & S or No. 5 Morse Available at Slight Extra Cost.

Clip ad to your letterhead and send for Literature

K. O. Lee Company, Aberdeen, S. D.

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MARVECO LIVE CENTERS

Guaranteed to outperform and outlast any other LIVE CENTER.

The WHOLE HEAD turns on Double Row Ball Bearings for Radial Load and Tapered Roller Bearings for Thrust Load.

MARVEL TOOL & MACHINE CO.
1086 North River Road • St. Clair, Michigan

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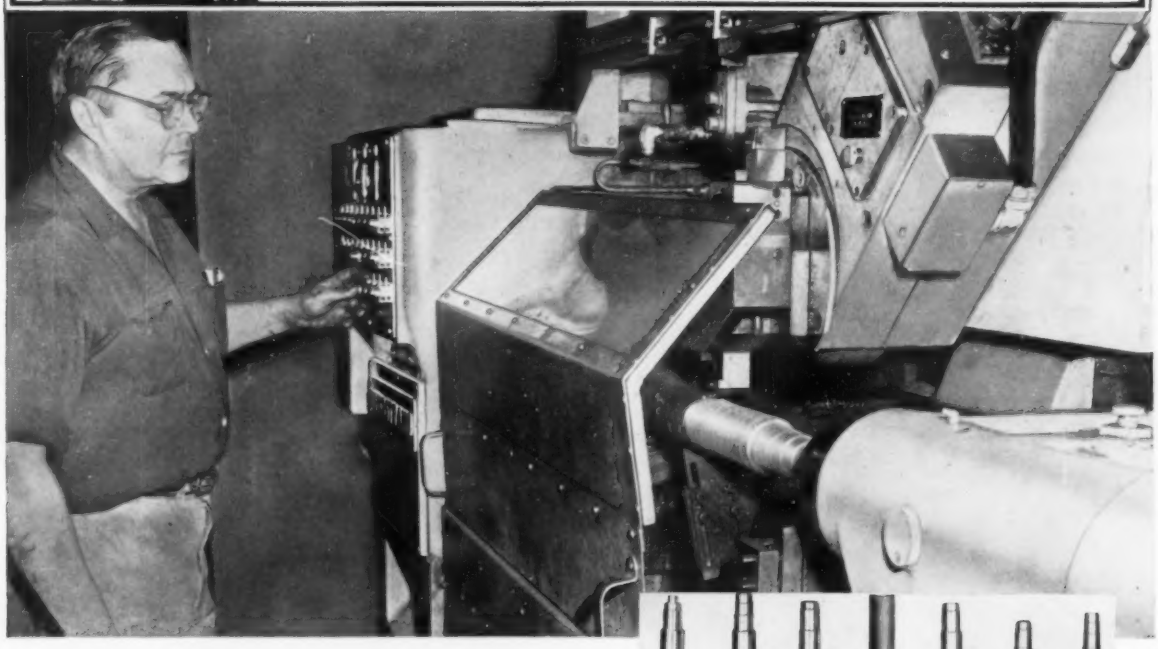
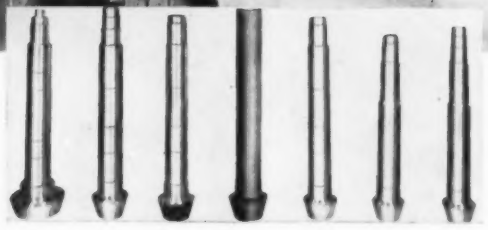
SUNDSTRAND

"ENGINEERED PRODUCTION" NEWS





Tracer Turning of Bevel Pinion Shafts Slashes Setup Time, Cuts Costs, Improves Finish

A combination of faster setups and reduced machining times enables one Sundstrand automatic tracer lathe to replace two machines formerly required for turning five sizes of tractor bevel pinion shafts. Increased production, reduced set up time, closer tolerances, simplified operation, reduced costs, and finer finishes are the benefits of this change to Sundstrand.

Changeover time was reduced from an average of 8 hours to 1 hour on the multiple small lots turned on this lathe. Rough forgings are ruff and finish turned in one set up using an automatic indexing tool turret equipped with a ruff and finishing tool. Finishes were improved 50% over previous machining method and tolerances are consistently held within the specified limits to eliminate rework.

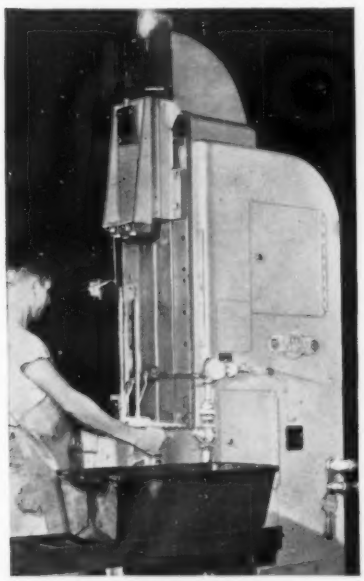
Parts are loaded manually and clamped with an air operated chuck and tail-stock. Completely automatic operation is push-button actuated and the machine can be set up to provide up to four cutting cycles.

Chip disposal doesn't present any problem despite a high rate of metal removal because the machine has a large open chip chute and is equipped with automatic chip disposal.

Versatility and Dependability Keynote Broach Performance

More than 15 types of automotive, mining, industrial, and electrical equipment parts are broached on four American Broach machines at this Midwestern forging plant. Quick changeover and long broach life are as important as precision in making this a highly successful installation.

Properly designed broaching tools permit part tolerances to be maintained during long production runs with minimum resharpening. This partnership between tools and machines — adding the right fixturing where required — is the only sure way to provide top performance on every broaching job.



American three-way machine can be used for push, pull or surface broaching.

Typical parts broached by one customer on Sundstrand - American machines.

Tape-controlled positioning table permits precision hole drilling on two parts at a time.

Tape Control Simplifies Multiple Hole Drilling

Precision doesn't have to be expensive — this fact is proved by applying Sundstrand "Engineered Production" to this multiple hole drilling job. The special drilling machine is designed around Sundstrand's Jigmatic tape-controlled positioning table and uses drilling heads with minimum center distance requirements.

Two parts are drilled at a time without requiring expensive fixturing, lengthy setup times, or special operator skills. All the operator does is load and unload parts while the punched tape and electronically controlled table handle the actual drilling operations.

Considerable flexibility is inherent in the design. Other parts of similar size can be drilled by merely changing tapes. In addition, drill heads can be repositioned readily.

Rigidmil Triples Production on Close Tolerance Job

Tripling production per eight-hour shift — from 365 cylinder heads formerly to 1125 now — is the record of this Sundstrand Rigidmil. Not only is production of the aluminum alloy parts increased substantially, but also the parts are machined to a .0002-inch tolerance.

Extreme simplicity of operation, ability to load one part while another is milled, and exceptional machine rigidity all play equally important parts in attaining production records like this one. Sundstrand builds an extremely broad range of standard machines and backs them up further with semi-standards and specials, where required. This complete line, together with Sundstrand's unmatched production milling experience, is your assurance of getting the best milling machine for the job.

Two workholders with hydraulic clamping permit loading one part while another is being machined.

Additional Information on the broad line of Sundstrand machine tools is available in Bulletin 712. Write for free copy today.

BROACHING TOOLS BROACHING MACHINES

SUNDSTRAND MACHINE TOOL

DIVISION OF SUNDSTRAND CORPORATION

BELVIDERE, ILLINOIS

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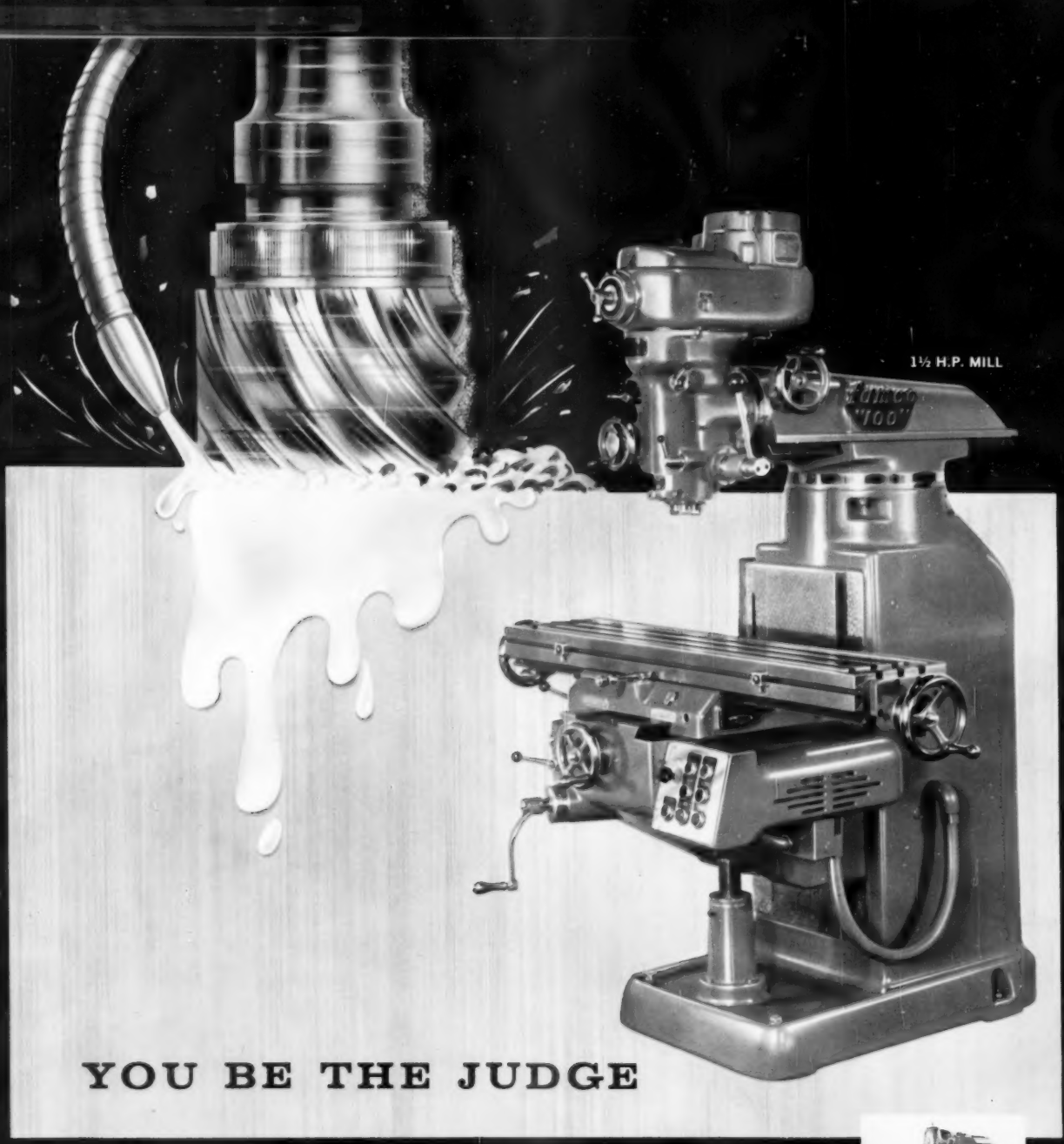


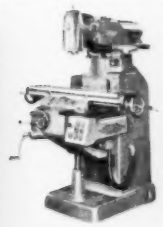
1½ H.P. MILL

YOU BE THE JUDGE

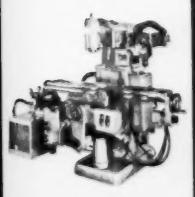
Some of our customers are hardboiled characters who cut their teeth on blue chips and were weaned on cutting oil. No kidding, they are really down to earth. Yet they have told us that the Famco mill is the finest mill they have ever used.

Naturally, they have an easy time convincing us. We build them. But how can you be convinced?

We would like your opinion! Write for the brochure describing these machines or ask for the address of your nearest dealer. We'll be happy to oblige. In that way, you can judge Famco's milling machine superiority for yourself.



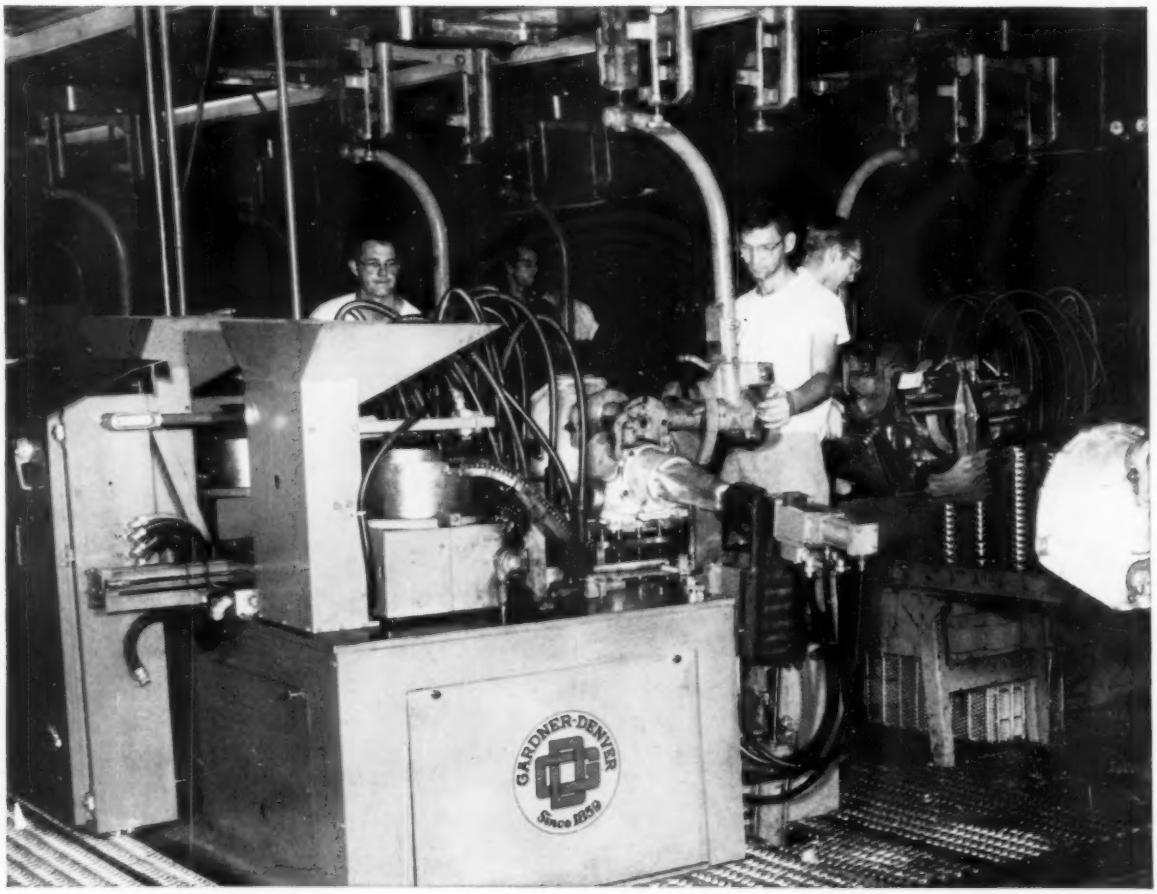
2 H.P. MILL



TRACER MILL

FAMCO MACHINE COMPANY KENOSHA 1, WISCONSIN

Manufacturers of:
Milling Machines, Presses • Air, Arbor, Power, Foot • Squaring Shears, Band Saws.



Ford speeds transmission production with special air-powered machines

IN INDUSTRY — SPEEDING THE PACE, the Gardner-Denver specialist is an integral part of the team. He works side by side with engineers and designers, helping to solve their problems. At Gardner-Denver there's no substitute for men—our 100-year philosophy of growth.

Three special pneumatic machines—designed by Gardner-Denver specifically for Ford Motor Company—step up production of automatic transmissions. These units automatically and simultaneously feed cap screws, hold and support the transmission, and set the screws on the oil pan assembly in a fraction of manual time.

This example is typical of the many tough problems that Gardner-Denver solves for production men. If you need a special multiple-spindle machine to speed assembly, Gardner-Denver specialists will work with your tool engineers to design and build one that exactly fits the job. Contact your Gardner-Denver representative for details.

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

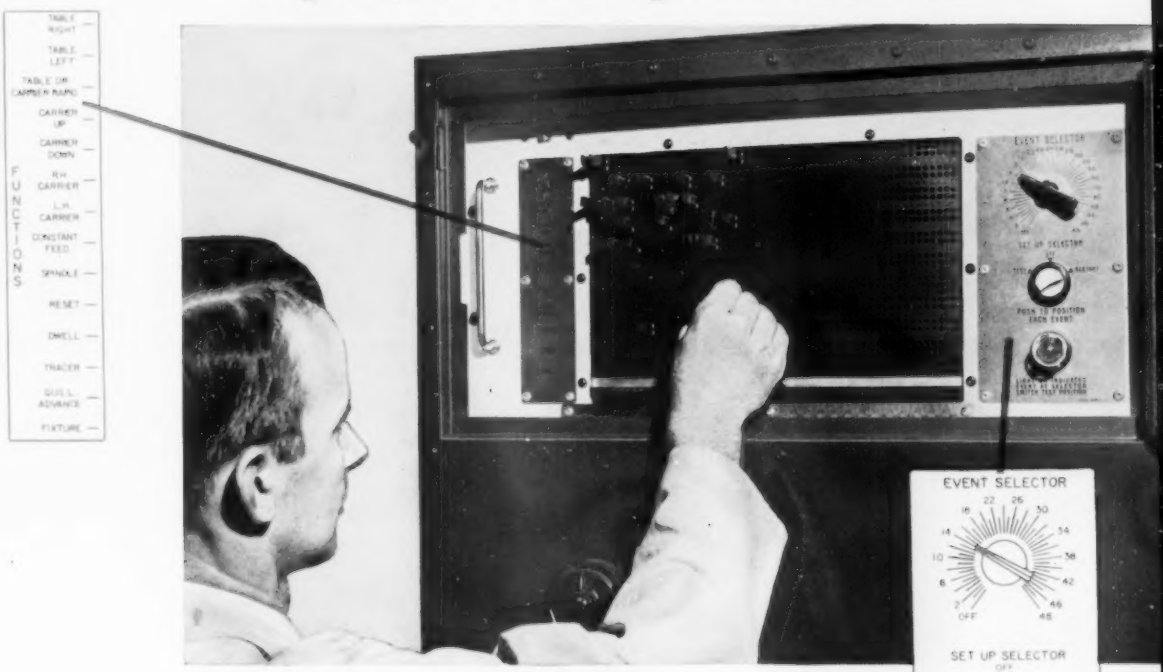
GARDNER-DENVER

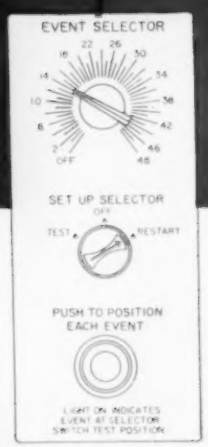
Gardner-Denver Company, Quincy, Illinois

In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario

New CINCINNATI Telematic Control

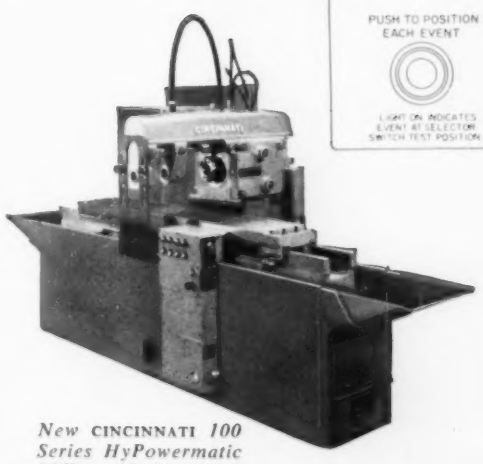
Programs Automatic Milling Cycles through Simple  *Plug-in Selections*





Cost advantages of automatic cycle milling now are available for smaller lots than ever before. With new CINCINNATI Telematic Control the operator programs all automatic functions of the cycle by merely inserting plugs in a panel board. If desired, a mask can be made for repeat jobs, exposing only the necessary holes. In addition to controlling all functions or movements of the machine table and spindle carrier, Telematic provides for auxiliary operations such as fixture clamping or indexing. A row of 24 holes opposite each machine function allows the operator to plug in complex automatic cycles involving up to 24 events. Additional panels, like the two-unit illustrated, can be supplied.

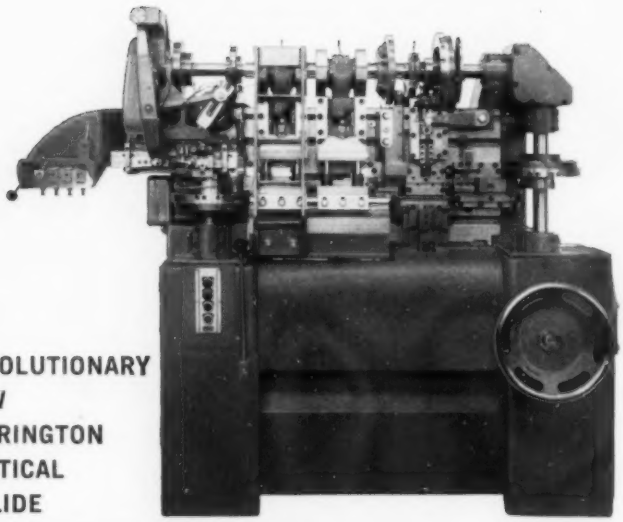
Telematic is the newest, most versatile and simplest of the operator-controlled programming methods. It is available on CINCINNATI 100 and 200 Series HyPowermatic Milling Machines. For details, write today for catalog M-2020-1. **Milling Machine Division, The Cincinnati Milling Machine Co., Cincinnati 9, Ohio.**



New CINCINNATI *100 Series HyPowermatic Milling Machine with 36" table travel.*

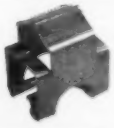
KNEE TYPE AND BED TYPE MILLING MACHINES • DIE SINKING MACHINES
CUTTER AND TOOL GRINDERS • ELECTRICAL DISCHARGE MACHINES

CINCINNATI®
MILLING MACHINE DIVISION



REVOLUTIONARY NEW TORRINGTON VERTICAL 4-SLIDE

PAID FOR ITSELF IN FOUR DAYS



PRODUCING THIS PART

Close-tolerance
enameling wiper die . . .
having 26 critical dimensions . . .
produced by General Electric
Industrial Heating Dept.

AT FOUR TIMES THE SPEED

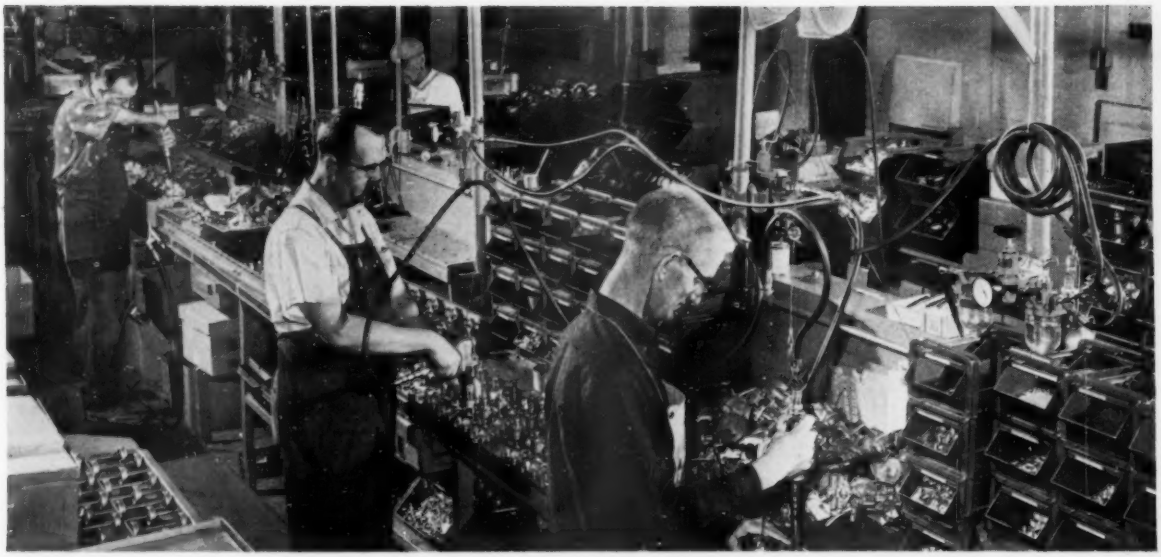
With one machine
replacing five
progressively tooled OBI presses . . .
and producing the part
in one-fourth the time.

AND ONE-THIRD THE COST

Saving $13,500
on a single production run
of only three days duration!

This important new production tool, the Verti-Slide, offers sensational savings in direct and indirect labor costs, parts inventory, and floor space requirements . . . through elimination of secondary operations, drastic reduction in production man-hours, and lower tooling, down-time and materials handling costs. Write or call today for complete technical data . . . or a Torrington sales engineer.

THE TORRINGTON MANUFACTURING COMPANY
TORRINGTON, CONNECTICUT • VAN NUYS, CALIFORNIA • OAKVILLE, ONTARIO



How to increase the life of your air tools and cylinders

...Norgren Lubro-Control Units reduce wear, improve equipment performance and cut maintenance costs.

To get maximum life from your air tools and other pneumatic devices, it is essential to filter the compressed air, control its pressure and to provide proper lubrication.

Filter removes abrasive solids and corrosive liquids

Compressed air as it comes directly from an air line generally carries with it dirt, pipe scale, rust and various liquids. If these substances are allowed to be carried by the air into your air tools, cylinders and other air-operated equipment, they will cause excessive wear and corrosion. The operating life of your air-devices will be cut short, and maintenance costs will be high. An air line filter must be used to remove these abrasive solids and corrosive liquids from the compressed air.

Regulator controls pressure

The fluctuating pressure of your compressed air system should be controlled by a pressure regulator. The regulator holds the pressure constant at the working pressure at which the pneumatic equipment will operate most efficiently.

Micro-Fog Lubrication ideal for air-equipment

Finally—and most important—pneumatic equipment must be given the right amount of lubrication. The best way to provide this lubrication is to put a lubricant into the air stream that powers the equipment.

A Micro-Fog Lubricator injects a fog of extremely fine particles of oil automatically and continuously into the air stream. It can be adjusted to meter just the right amount of oil for proper lubrication.

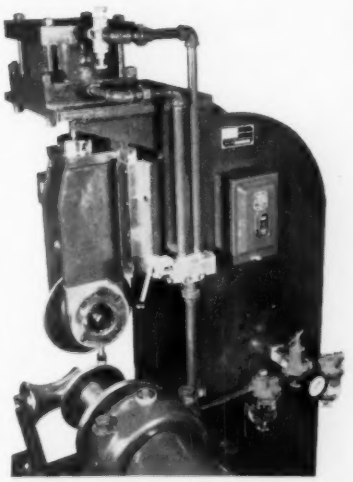
Micro-Fog particles are extremely fine. When injected into the air stream, they are like dry smoke until they reach the point to be lubricated. Because of this, Micro-Fog can be conveyed long distances and through complex piping systems without condensing into larger oil particles in the air line.

Norgren Lubro-Control Unit:

This unit consists of:

1. An air line filter.
2. A pressure regulator.
3. A Micro-Fog Lubricator.

It gives you these important benefits: better equipment performance, less wear, longer service life, less down time, lower maintenance costs.



The Norgren Lubro-Control Unit on this pipe cutting machine keeps the air cylinders operating at top efficiency. Without the Norgren unit, it was found virtually impossible to get the close control that is vital to the operation of the machine.

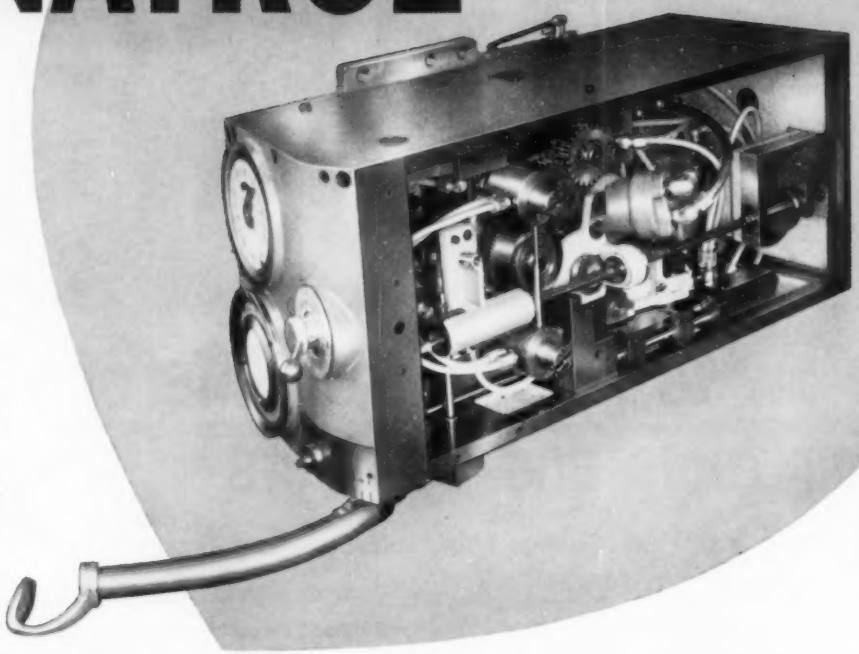
***FOR COMPLETE INFORMATION,* call your nearby Norgren Representative, listed in your telephone directory — or WRITE FOR DESCRIPTIVE LITERATURE.**

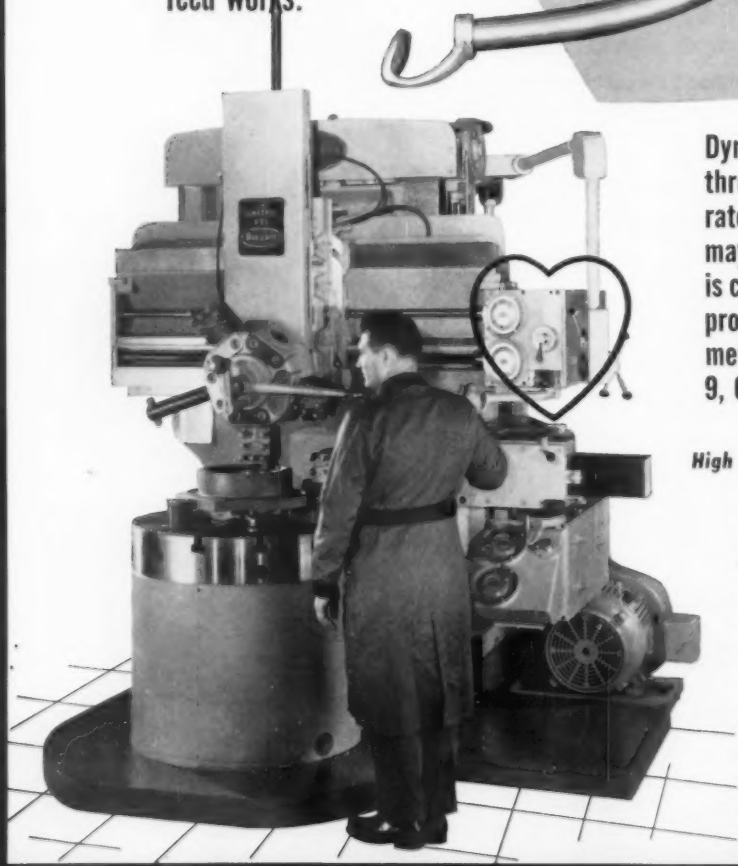
C. A. NORGREN CO.

Founded in 1926
3447 SOUTH ELATI STREET
ENGLEWOOD, COLORADO

This is the Heart of DYNATROL*

By means of a single lever or from a simple remote control all head motions, traverse and feed engagement are accomplished through this revolutionary new feed works.





Dynatrol* provides infinitely variable feed rates throughout the full range and variable traverse rates from zero to nine feet per minute. Feed rates may be advanced or retarded while the machine is cutting to obtain maximum tool performance and productivity. Ten sizes from 26" to 144" table diameter. Send to The Bullard Company, Bridgeport 9, Conn. for complete catalog.

High Spot Features of the Dynatrol *V.T.L. include:

VERSATILITY

Available equipment includes: Bullard variable speed drive for infinitely variable table speeds throughout the full range with no loss of usable horsepower. Fully automatic operation by Bullard Man-Au-Trol or point-to-point or continuous path numerical control systems.

Unique Size-Au-Trol* for accurate positioning of all heads. Contouring attachments: Hydraulic, electronic or electro-hydraulic. Four of five-sided power-indexing turret heads. Thread cutting, drum scoring and angle turning attachment. Power-operated chucks.

COMPACTNESS

The new Bullard Dynatrol V.T.L. is compact in design, rigid in construction, lower in height, reduced in floor area.

EASE OF MAINTENANCE

Automatic lubrication throughout . . . fewer parts . . . fewer adjustments . . . easily accessible.

*Trade Mark

"YOU CAN'T BEAT A BULLARD" BULLARD

They All Agree... You Can't Beat a Simonds High Speed Steel Metal Cutting Band Saw

Tom— the band saw operator, says:

"With Simonds saws I get straight, accurate cuts with a smooth finish."

Dick— the production manager, puts it this way:

"Since we've been using Simonds we lose lots less downtime for blade changes. Simonds blades seem to stand up better under high speeds and heavy feeds. Our cut-off production results are better."

and Harry— the purchasing agent, says:

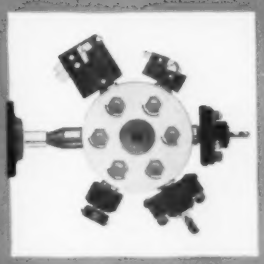
"We've been using Simonds bands for some time now. I like the easy availability from our local distributor. We don't have to wait for delivery or for service."

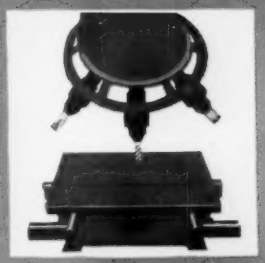
Why not put a Simonds High Speed Steel Metal Cutting Band to work for you and find out how much better it really is? Call your Simonds Distributor now.

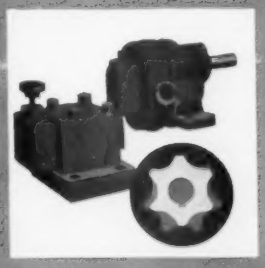
SIMONDS
SAW AND STEEL CO.
FITCHBURG, MASS.
For Fast Service from Complete Stocks Call your
SIMONDS Industrial Supply DISTRIBUTOR

Factory Branches in Boston, Chicago, Shreveport, La., San Francisco and Portland, Oregon
Canadian Factory in Montreal, Que., Simonds Divisions: Simonds Steel Mill, Lockport, N. Y.
Heller Tool Co., Newcomerstown, Ohio, Simonds Abrasive Co., Phila., Pa., and Arvida, Que., Canada

to help you make more for less

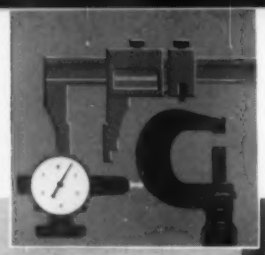




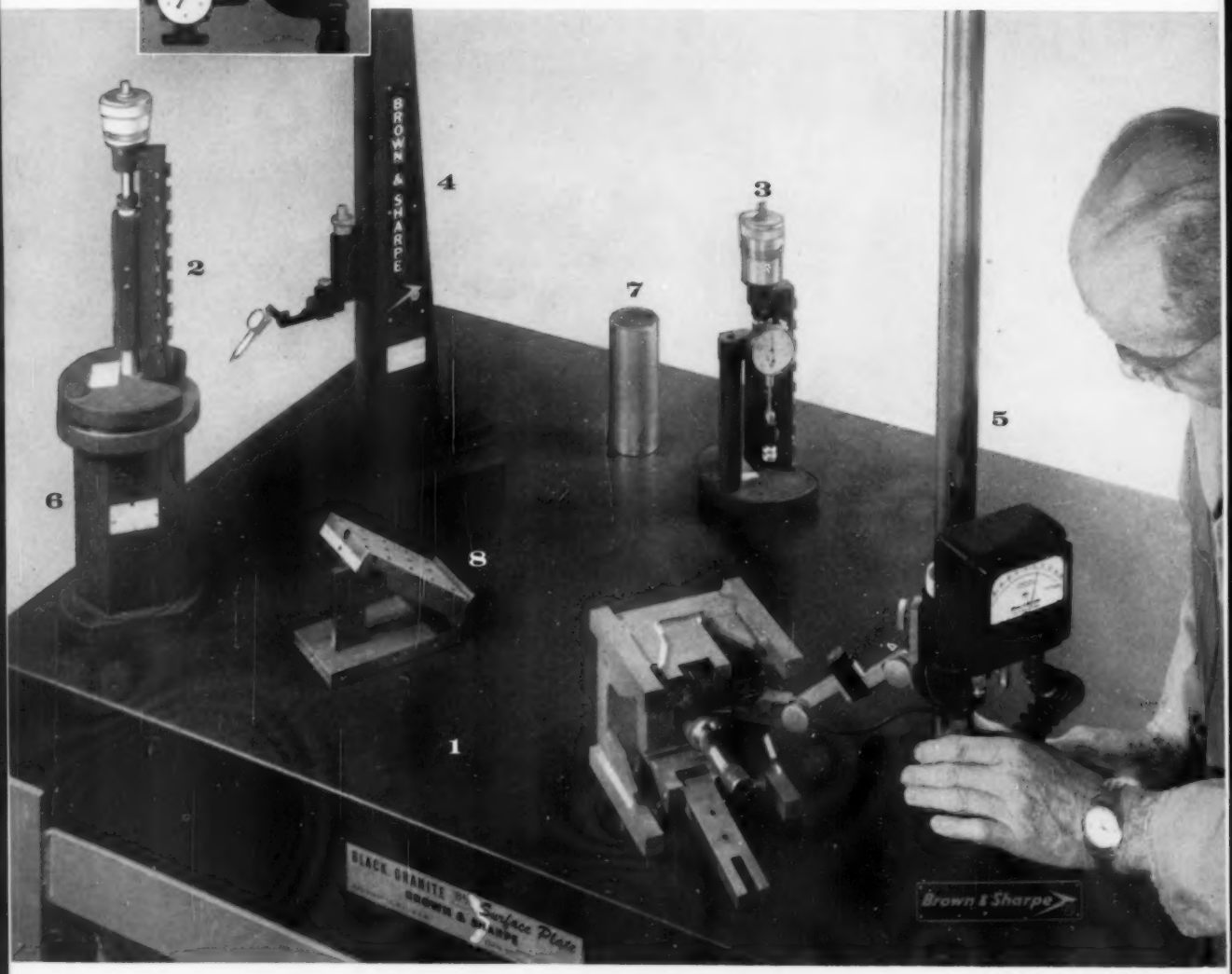


Brown & Sharpe

PRECISION CENTER



TO HELP YOU MAKE PRECISION MEASUREMENTS EASIER AND FASTER . . .



8 Brown & Sharpe tools bring you unusual new precision and speed in surface plate work

1 B&S Black Granite Surface Plate is the flattest, most indestructible base you can buy.

2 Hite-Set® establishes heights fast and easily in ten-thousandths.

3 Dial-equipped Hite-Icator® works even faster to provide the same accuracy.

4 Hite-Chek® transfers measurements without losing a single ten-thousandth. It is "chatterproof."

5 Super Hite-Chek works even finer; in 25 millionths and better. It's transistorized; a snap to use.

6 B&S 9" Riser Blocks, made to gage block accuracy, stack under other tools in measuring tall work.

7 B&S Direct Reading Cylindrical Square shows out-of-squareness directly in 2 ten-thousandths.

8 B&S Inspection Sine Plate sets angles with unusual precision. Available in 5" and 10" simple and compound models. Ask your Brown & Sharpe distributor to show you the complete line of accurate B&S surface plate tools. Brown & Sharpe Mfg. Co., Providence 1, R. I.

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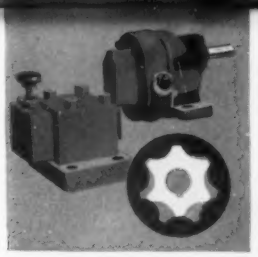
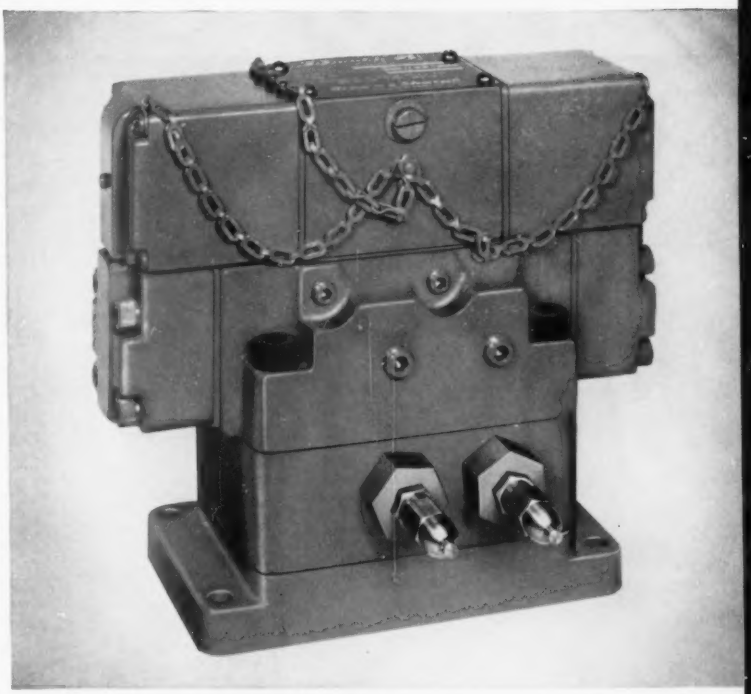


TO HELP YOU HANDLE FLUIDS MORE EFFICIENTLY... AND FOR LESS



Save up to 75% on valve installations with new Double A "Circuit-Stak"

Circuit-Stak valves are a new Brown & Sharpe concept: a "sandwich" of several valves required for a hydraulic circuit, assembled in one compact unit on a single sub plate.

You save up to 75% of the usual installation cost for separate valves, because Circuit-Stak installs as easily as a single valve — eliminates separate mountings and piping runs. Valves in the sandwich can be easily removed or replaced.

For literature on Double A hydraulic control valves, power units, Gerotor pumps, write Double A Products Co., a subsidiary of Brown & Sharpe Mfg. Co., Manchester Michigan.

Above: Simple Circuit-Stak combining double flow control valve, "sandwiched" under 4-way valve, costs about $36 less to install than if valves were separately mounted.

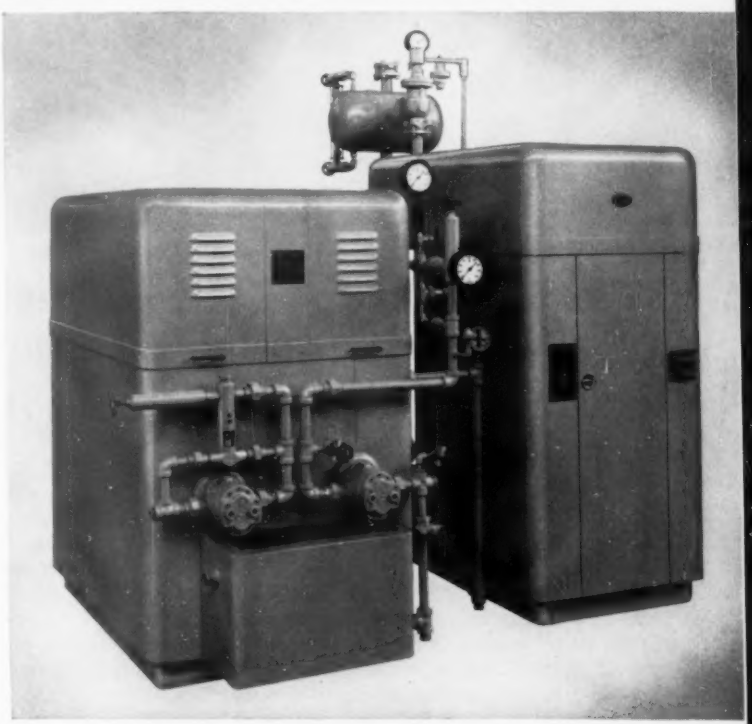
Below: Famous Votator chilling and plasticizing units for shortening and lard are manufactured by Girdler Process Equipment Division, Chemetron Corporation, Louisville, Ky.

Unusually long life of B&S pumps suits them for "Votator" units

The reasons why Brown & Sharpe rotary geared pumps have been built into "Votator" vegetable-shortening and lard processing units for over 15 years, are important to any pump user . .

First, B&S tolerances between moving parts are so close that they reduce slippage of hot oils to an absolute minimum — at 250-300 psi. Second, B&S fine internal finishes assure extra-long service life. Equally important, the B&S pumps that meet Votator requirements so well are *inexpensive* — available right from stock.

Send for your copy of the new Catalog No. 36P, which describes the complete line of B&S gear, vane and centrifugal pumps. Brown & Sharpe Mfg. Co., Providence 1, R. I.



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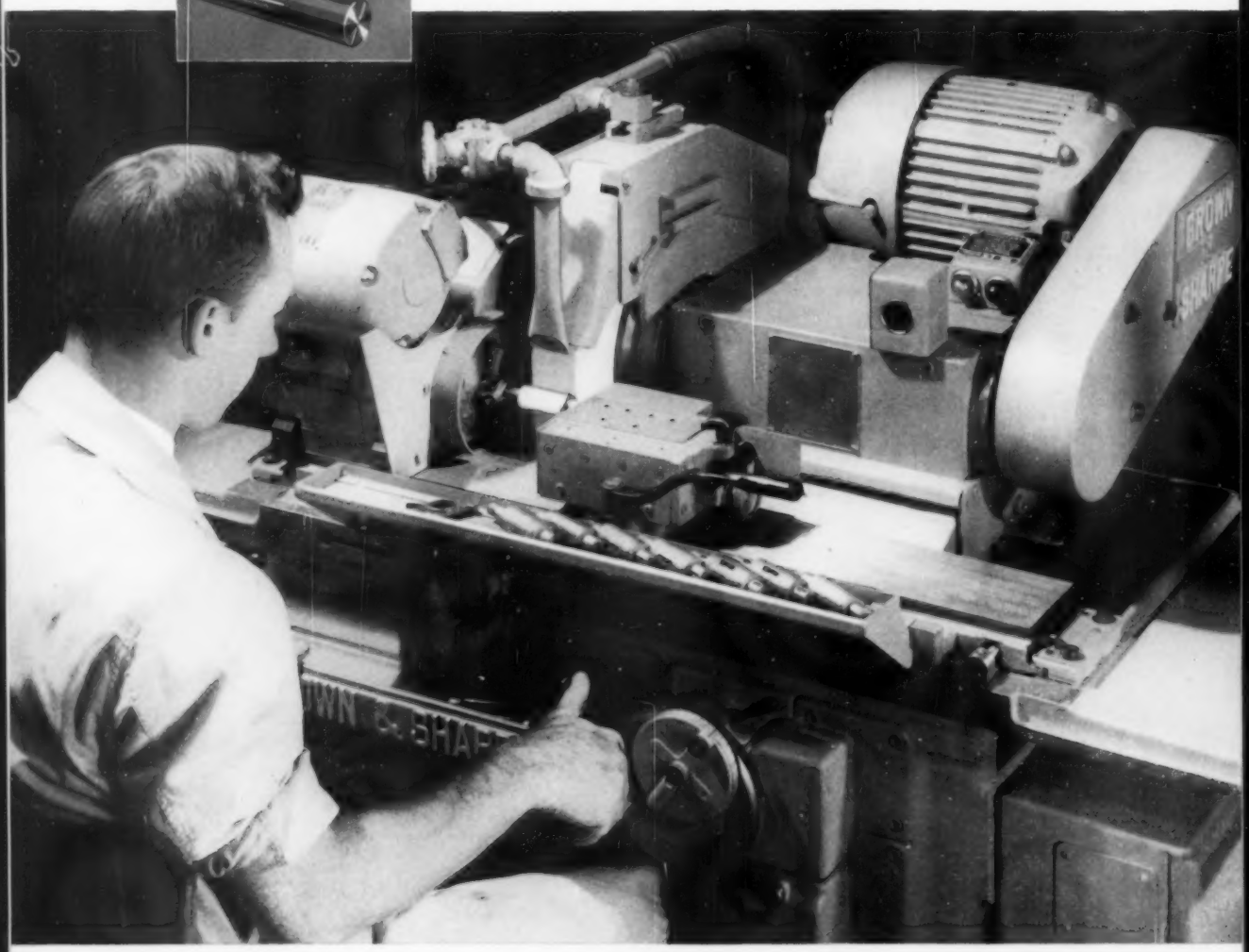
MMT-PE

TO HELP YOU GRIND MORE FOR LESS



New design No. 5 - the only plain grinder with a 5-year guarantee on a plain bearing spindle

The Brown & Sharpe No. 5 Plain Grinding Machine has remained first choice for production grinding of small parts for good reasons — its accurate repetitive sizing to split tenths, and its long record of cost-saving performance. Now, exclusive new advantages set today's top standards for operating efficiency and economy.

The interchangeable cartridge-type wheel spindle unit needs no adjustment, has self-contained lubrication — assures lasting accuracy in the low micro-inch range. The plain bearing unit is unconditionally *guaranteed for 5 years*. The spindle unit can also be furnished with super-precision, pre-loaded antifriction bearings.

Other design features available only in the new No. 5 include 1) super-smooth Oriflex drive in headstock; 2) "Permalign" footstock that permits fast, easy lever-operated work loading, and maintains accurate alignment; 3) flat swivel table top that is a horizontal working surface, hardened and ground for lasting accuracy.

Before you buy equipment for production grinding in the 1" range, get complete information on all the profit-saving features of the new No. 5. You'll see why it offers you by far the best return on your machine investment. Write: Machine Tool Division, Brown & Sharpe Mfg. Co., Providence 1, R. I.

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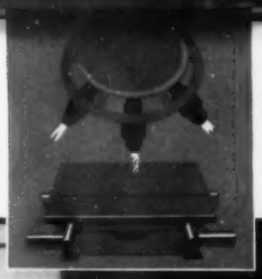
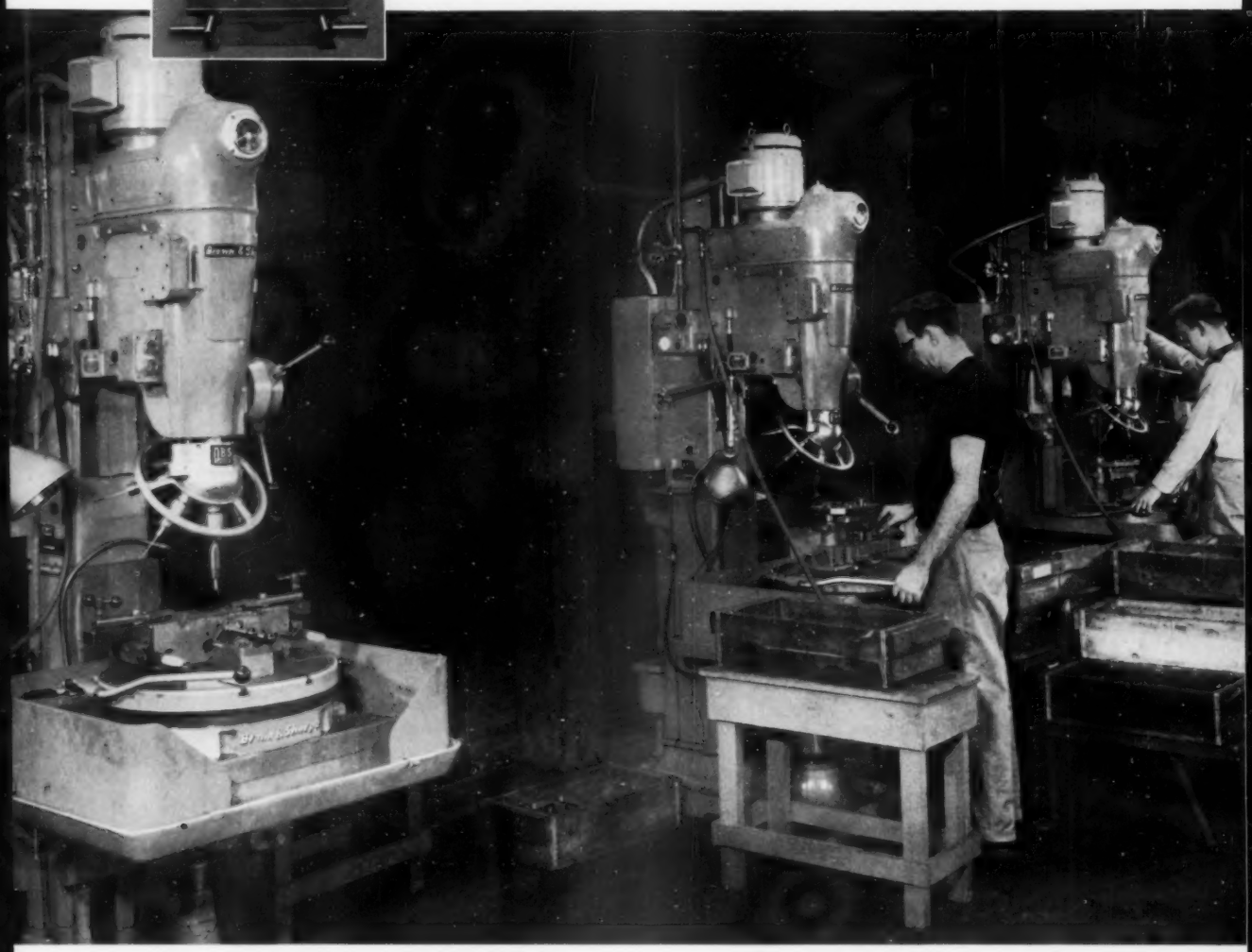
MMT-PE



TURRET DRILLING MACHINES...
TO HELP YOU DRILL MORE FOR LESS



American Hardware speeds production with Brown & Sharpe Turret Drilling Machines

At The American Hardware Corporation, three B&S Model A Turret Drilling Machines are used to machine 15 fitting points in mating parts. B&S Positioning Tables and simple holding fixtures maintain accurate relationship of machined surfaces.

With previous method, involving transfer of parts to several machines, dimensional relation of fitting points frequently varied. Parts had to be individually mated in assembly, often by hand filing and fitting.

Five hollow-milling and two face-milling operations are performed on the B&S Turret Drilling Machines, as well as drilling, tapping, and reaming. In all, 21 operations are performed on each complete part in 4 minutes total machining time.

Find out how you can save with Brown & Sharpe Turret Drilling Machines — in work transfer and set-up time, in jig costs, in tool wear and maintenance — in capital investment and floor space. Write: Turret Drilling Division, Brown & Sharpe Mfg. Co., Providence 1, Rhode Island.

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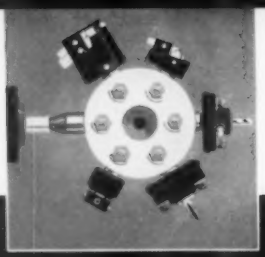
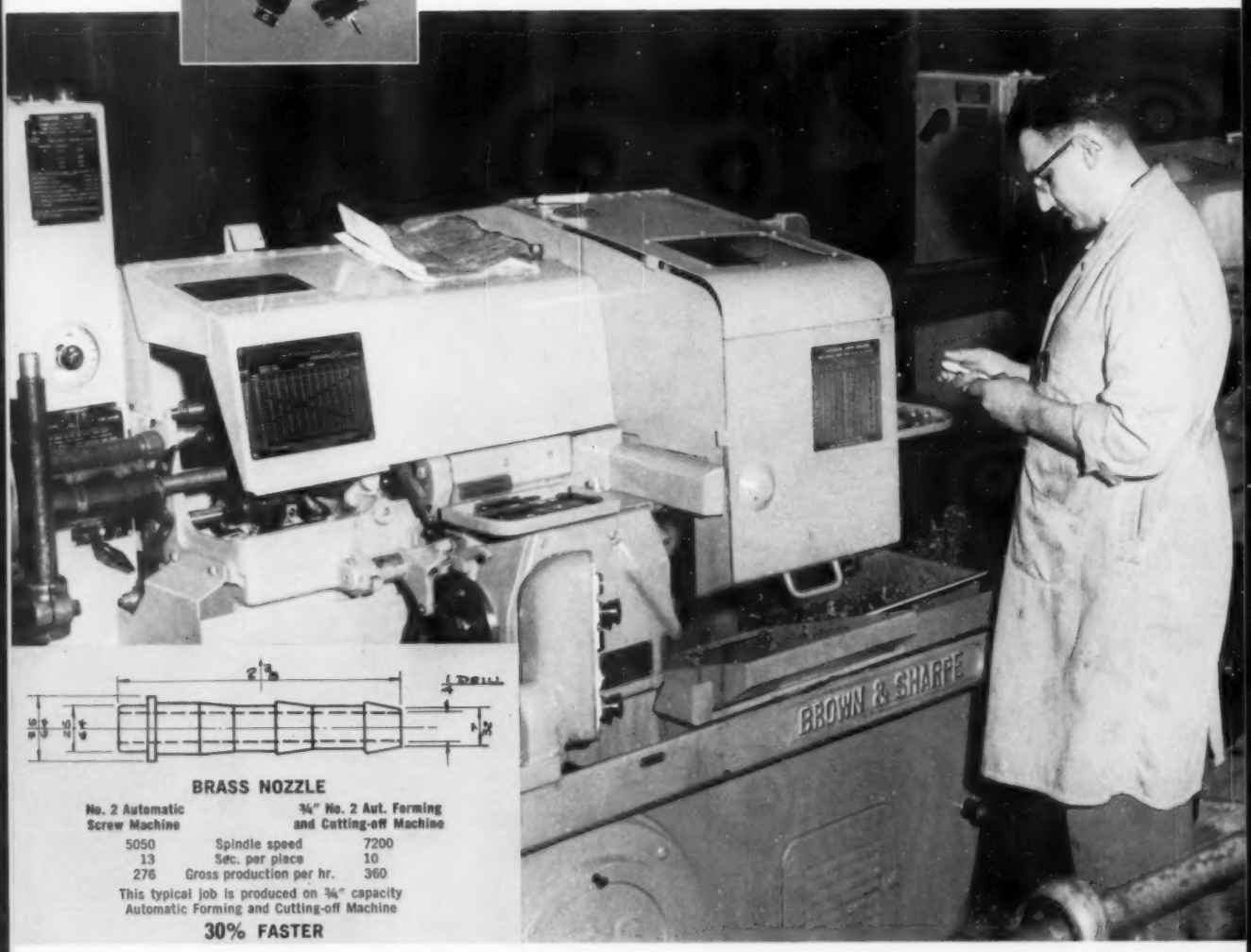
MMT-PE



TO HELP YOU REDUCE
SCREW MACHINE PRODUCTION COSTS



BRASS NOZZLE

No. 2 Automatic Screw Machine		¾" No. 2 Aut. Forming and Cutting-off Machine
5050	Spindle speed	7200
13	Sec. per piece	10
276	Gross production per hr.	360

This typical job is produced on ¾" capacity Automatic Forming and Cutting-off Machine

30% FASTER

Now - No. 2 Automatic size range and productivity - in a high speed forming and cutting-off machine

The new Brown & Sharpe No. 2 Automatic Forming and Cutting-off Machine, with six-hole turret and vertical slide, will perform practically all automatic screw machine operations except threading. For the big volume of bar work that does not require spindle reversal or stopping, it delivers all the record-setting efficiency and precision of the new-design B&S Automatics.

You get all the increased production potential of higher spindle speeds — up to 7200 R.P.M. for free-machining materials, with a full range down to 315 R.P.M. for tough alloys. You can take full advantage of carbide tooling and make multiple savings in production time. You get tolerances to 0.0005" on many jobs when forming or turning from the turret, with excellent surface quality. You get extra adaptability for combined operations, and for faster set-ups. Your equipment investment is substantially reduced, with a big plus in productivity.

The new No. 2 is available in 3 sizes — ¾" capacity with 18 speeds from 7200 to 450 R.P.M.; 1¼" capacity with 18 speeds from 5050 to 315 R.P.M.; 1½" capacity with 16 speeds from 3500 to 315 R.P.M. For complete details, write: Machine Tool Division, Brown & Sharpe Mfg. Co., Providence 1, R. I.

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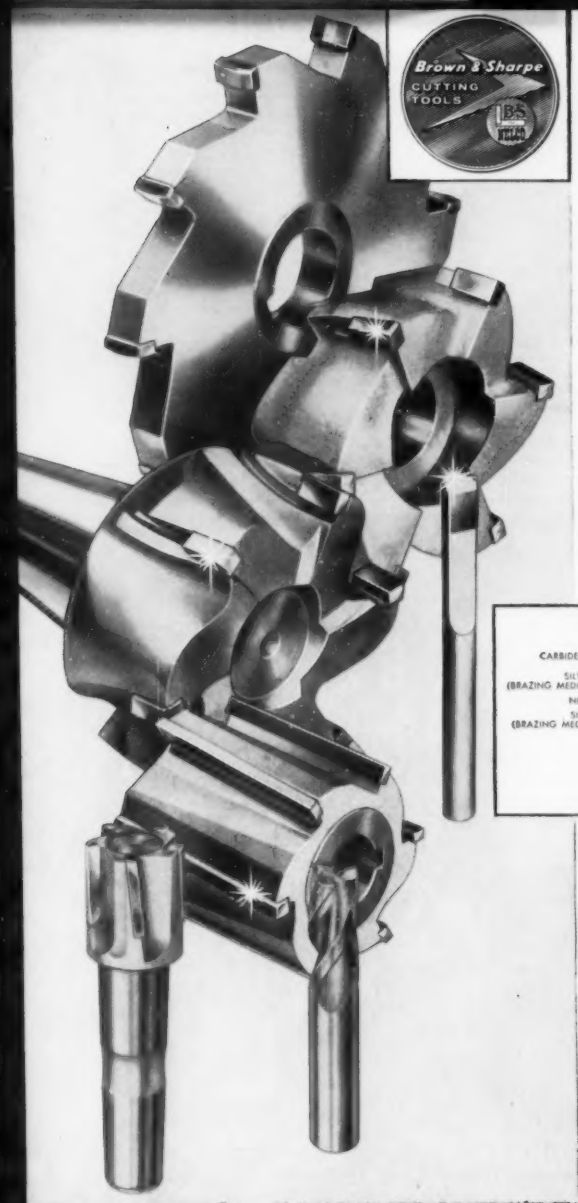
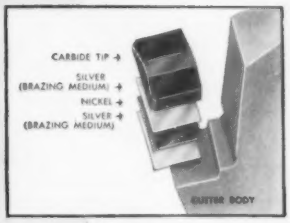


FOR THAT EXTRA EDGE IN PRODUCTION!

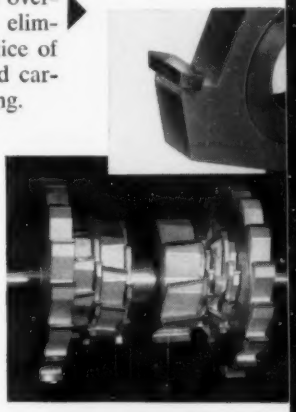
HOW THE BIG ADVANTAGES ARE ENGINEERED INTO NELCO TOOLS

Specific dollars and cents production benefits are the result of exclusive features engineered into Nelco Tools.

So that you may benefit too, here are facts that should influence your decision when comparing and specifying carbide tipped tools.



Generous carbide tips overhang steel bodies to eliminate the costly practice of grinding both steel and carbide when resharpening.



Carbide tips are sandwich brazed to give a solid, rugged one piece tool engineered for long trouble-free life.

Nelco "standard" and "special" cutters are engineered to perform multiple precision milling operations when ganged.

How Nelco Correct Carbide Grade & Fast Service Solve Tough Milling Problem

Indianapolis

Nelco distributor faced with customer problem: Slot tough, abrasive Mallory #1000 containing 90% tungsten. All other cutters failed.

Nelco engineered correct grade of carbide into Series 100 Tri-Helix side milling cutter. Air mailed cutter to distributor for speedy delivery to customer.

Nelco-distributor team had this job running in record time!

When you specify Carbide Milling Cutters—specify *Nelco*. They are the ones that have solutions to your toughest milling problems engineered into every tool.

Send for the easy-to-use Brown & Sharpe-Nelco Condensalog to: Cutting Tool Division, Brown & Sharpe Mfg. Co., Providence 1, Rhode Island.

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Brown & Sharpe
HIGH SPEED STEEL CUTTING TOOLS

NELCO
CARBIDE CUTTING TOOLS

high lubricity in water

Stuart's SOLVOL liquid cutting compound

You may not be using soluble oils for "big chip" machining. But there is a super-lubricity compound—Stuart's Solvol—designed specifically for these jobs. A cutting fluid more and more of America's top companies are using for broaching, milling, and heavy-duty turret lathe work.

Compounded of a high-lubricity fatty oil, petroleum base, and a heavy-duty emulsifier, Solvol gives you the right combination of lubricity and cooling action for economical tool life at efficient machine speeds. Here's why . . .

Extremely fine particles of fatty oil are suspended in water like millions of delicate organisms under the sea. Fatty oil that comes from the sea—the best fat for lubricity money can buy. Solvol's high concentration of sperm oil allows chips to slide over the tool face without high friction and heat build-up. Stops chip welding and tool breakdown.

You get all these advantages in a water-mix compound that cools faster, eliminates smoke, handles a wide range of cutting operations at the lowest possible tool lubrication cost.

So, when you make the switch from straight oils to a water-mix cutting fluid, don't sacrifice lubricity. Because Solvol combines both—the cooling capacity of water, with the extra lubricity you need for economical machining.

Stuart

low friction · high finish

Stuart's CODOL liquid grinding compound

Grinding experts will tell you there's only one way to get a slick surface finish without going to extremely fine grit wheels or a straight grinding oil—and you don't have to give up wheel life or cooling action to get it.

That is by utilizing the balanced lubricating and scrubbing action of a water-mix like Stuart's Codol liquid grinding compound. For Codol's balanced formula provides the high surface finish advantages of a straight oil . . . in colloidal form . . . plus the cooling capacity of water.

Extremely fine oil particle size results in a near-transparent solution. Codol is not an opaque emulsion like most soluble oils . . . yet, it has none of the machine maintenance disadvantages of transparent compounds.

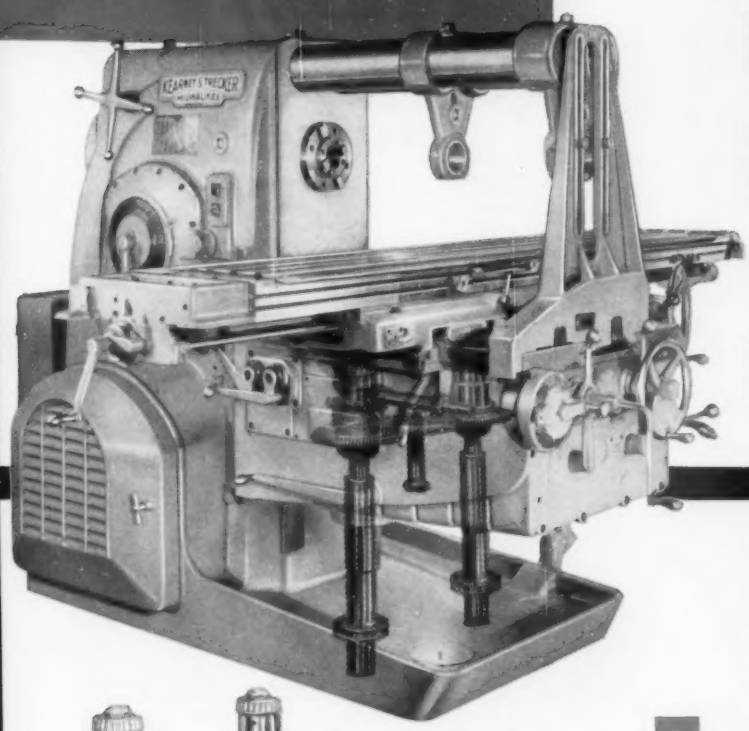
Use Codol when you want to keep grinding wheel inventory costs at a minimum and production efficiency right at peak.

Stuart

D. A. STUART OIL CO., LIMITED
2727 South Troy Street, Chicago 23, Illinois

Canadian D. A. Stuart Oil Co., Limited, P. O. Box 430, 43 Upton Road, Scarborough, Ontario, Canada

HEAVY-DUTY TF SERIES



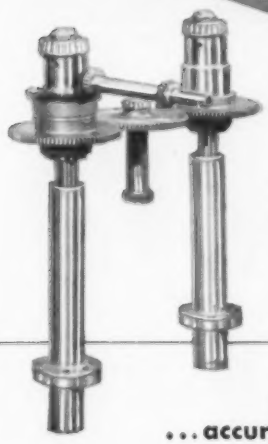
Heaviest cuts, highest accuracy through balanced design

KEARNEY & TRECKER TF SERIES MILLING MACHINES — WITH *BALANCED-ACTION* TWIN SCREW KNEE SUPPORT — INSURES RIGIDITY WHERE IT COUNTS

The twin screw knee support is just one of the many superior design features of the Kearney & Trecker *TF* Series heavy-duty, knee-type milling machines . . . unequaled in their class for rigidity and long-lived accuracy.

Other important features of the *balanced design TF* Series that add up to maximum rigidity and accuracy include — massive column with solid, extra-wide, full-length way — one-piece knee with wider and longer ways — increased bearing area between solid cast table and saddle — double "Vibra-Void" overarms on plain and universal models — perfectly balanced three-bearing spindle — and many other engineering achievements that make these "mills" a *best buy* for versatile heavy-duty machining.

Choose from 48 models in plain, universal and vertical styles in size Nos. 2, 3, 4, 5 and 6 with 10 to 50 hp.



EXCLUSIVE twin elevating screws

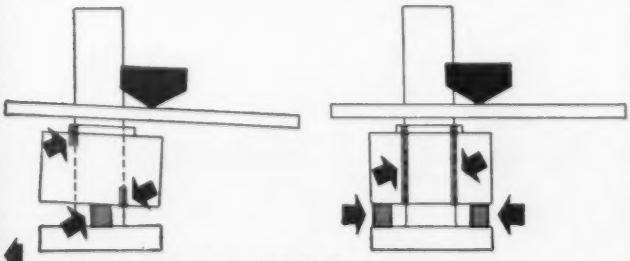
Three large, precision-hobbed, equidiameter plate gears provide simple, maintenance-free power transmission to both elevating screws. This positive and accurate drive maintains perfect synchronization of elevating screws.

DEFLECTION REDUCED . . . accuracy increased 3 times over single screw design

Conventional Single Screw Design—color indicates shorter length of contact between knee and column ways when heavy work load is off-center. The result is table deflection, strain on screw and excessive uneven wear on ways.

New TF Twin Screw Design—color indicates no change in contact between knee and column ways with heavy work load off-center.

Result: maximum rigidity and accuracy with minimum wear on screws and ways.



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FOR THE WHOLE STORY . . . call your local Kearney & Trecker representative or write today for Bulletin TF-58 . . . 54 pages packed with eye-opening facts and complete specifications. Check the complete Kearney & Trecker line before buying any "mill."

KEARNEY & TRECKER MILWAUKEE

KEARNEY & TRECKER CORP.
6800 W. National Ave. • Milwaukee 14, Wis.
Phone — GReenfield 6-8300
. . . Direct Distance Dialing Code 414

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ANOTHER "BUILDING BLOCK" BY HARTFORD Special

AIR HYDRAULIC DRILL UNIT

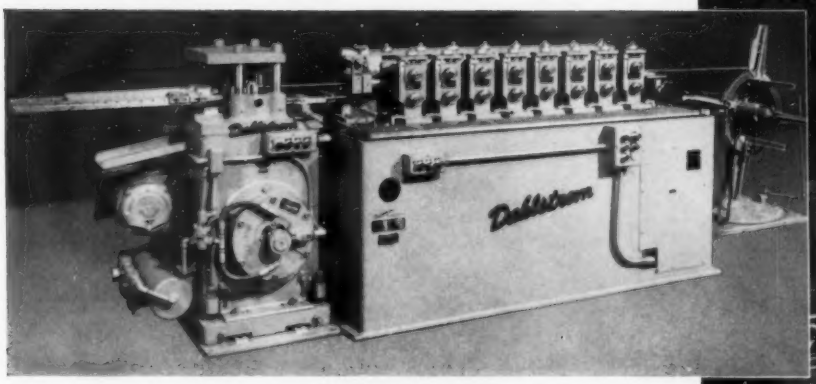
- 4" STROKE • UNITIZED
- SMALL SIZE • INTEGRAL AIR VALVE
- FIELD TESTED

COMPLETE INFORMATION . . . on the new Model 17-400 Drill Unit, including dimensions, specifications and other engineering data, is covered in Circular No. GC-400. Write now for your free copy. The Hartford Special Machinery Co., 3800 Homestead Ave., Hartford 12, Conn.

HARTFORD Special

THE HARTFORD SPECIAL MACHINERY COMPANY
HARTFORD 12, CONNECTICUT

COMPLETE ROLL FORMING LINES BY *Dahlstrom*

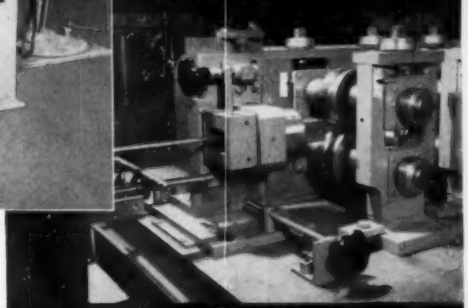


SAVE!

. . . Whether your problem is large or small, Dahlstrom has available "complete" Roll Forming Systems that can be tailored to your requirements.

Standard Dahlstrom Machines are available in integrated Roll Forming Lines or as individual units — Coil Lifts, Coil Reels, Roll Straighteners, Roll Forming Machines, Flying Die-Type Cut-Off Presses, Measuring Tables and Run-Out Conveyors.

Send us your problem.



Roll Former Features Micrometer Type Screw Adjustment

Dahlstrom MACHINE WORKS INCORPORATED

4223 W. Belmont Ave., Chicago 41, Ill., Phone: SPring 7-3670

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LepeL

HIGH FREQUENCY *Induction* HEATING

HARDENING
SOLDERING
ANNEALING
MELTING
BRAZING

LEPEL Electronic Tube GENERATORS — 1 KW; 2½ KW; 5 KW; 10 KW; 20 KW; 30 KW; 50 KW; 75 KW; 100 KW.

LEPEL Spark Gap Converters 2 KW; 4 KW; 7½ KW; 15 KW; 30 KW.

WRITE FOR THE NEW LEPEL CATALOG . . . 36 illustrated pages packed with valuable information.

All Lepel equipment is certified to comply with the requirements of the Federal Communications Commission.

LEPEL HIGH FREQUENCY LABORATORIES, INC.
55th STREET and 37th AVENUE, WOODSIDE 77, NEW YORK CITY, N. Y.

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RAVA ELECTRO-DYNAMIC BALANCING MACHINES

UNMATCHED FOR

- Speed
- Accuracy
- Ease of Setup
- Versatility
- LOW COST

It will pay you to get the facts about the complete line—for parts weighing from a few ounces to a ton or more.

Write today for Bulletin 57.

TINIUS OLSEN
Testing Machine Co.
2110 Easton Rd. • Willow Grove, Pa.

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DoALL

STAINLESS STEEL GAGE BLOCKS

...better in every way!

Stainless steel gage blocks are another DoALL first—created and perfected after 20 years of research for the ideal gage block material. They have been tested and approved by leading gage block users. Now they're ready for use in your laboratory or shop.

Check these 8 money-saving advantages:

- ✓ **STABILITY**—No growth or shrinkage of over .000002 in. per in. of length.
- ✓ **HARDNESS**—Over 68 Rockwell C any place on block surface.
- ✓ **WEAR**—More than three times the life of ordinary steel gage blocks.
- ✓ **CORROSION RESISTANCE**—Four to five times greater than regular steel blocks.
- ✓ **SURFACE FINISH**—Better than can be measured with a surface analyzer—.09 microinch AA.
- ✓ **WRINGABILITY**—Stainless steel gage blocks wring better than ordinary steel gage blocks.
- ✓ **COEFFICIENT OF EXPANSION**—Stainless steel gage blocks are in the range of most engineering materials.
- ✓ **BRINELLING**—Repeated spindle impacts do not Brinell the DoALL stainless steel blocks.

—plus these important bonus items:

With each set of DoALL stainless steel gage blocks you get these extra values at no charge:

1. a certificate of inspection covering each block in the set;
2. a complete kit for the care of gage blocks;
3. a compact, pocket-size plastic case;
4. educational booklets that explain how to make your set of gage blocks most useful and how to keep them in usable condition.

DoALL stainless steel gage blocks are available in standard sets of 38, 81, 84, 85, 86 and 88 pieces. Blocks are made in all decimal sizes from .050 in. to 4.000 in. and in fractional sizes from 1/16 in. to 7/64 in. Accuracies for AA blocks: plus .000002 in., minus .000002 in. Accuracies for A + blocks: plus .000004 in., minus .000002 in.

Call your local DoALL store today. Ask your DoALL Gage Specialist to demonstrate the new stainless steel gage blocks—without obligation.

GB-35

THIS IS A TYPICAL DoALL STORE

The DoALL Company, Des Plaines, Illinois

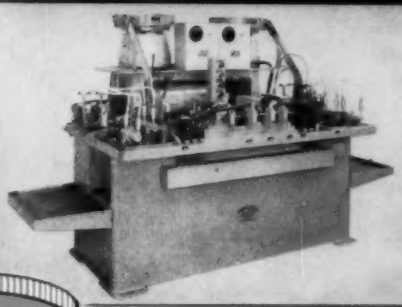
NEW IDEA FOR

"perpetual motion"

CAN DOUBLE PRODUCTIVITY

Bodine

CASE HISTORY NO. 51



BODINE AUTOMATIC CONTINUOUS double end TAPPER

OFFERS WIDE NEW TOOLING OPPORTUNITY

This new Bodine Basic Production Unit has demonstrated important cost reducing capability in the high speed tapping of low-cost, volume-produced parts.

The basic principle is simple and highly efficient . . . a double-ended, high-reversal spindle moves back and forth *continuously*, tapping at one end while reversing at the other . . . every motion being a working motion with essentially no idle time. Ample, wide-open tooling areas at each end allow great latitude in design of efficient devices for positioning, holding and ejection of work pieces which are continuously track-fed from automatic hoppers above.

Like all Bodine machines, this new unit has been refined in detail and ruggedly built to maintain *both* high speed and precision accuracy on long production runs. Spindles have lead screw control. All components, including the time-tested #52 Tapping Spindle, are thoroughly PROVEN Bodine standardized units.

Once again, Bodine presents an unusually efficient "special" for specific applications minus the usual engineering headaches, time-lag and high cost of special machinery. The #58 Continuous Tapper is rugged, compact (only 22 square feet), easy to tool, operate and maintain . . . and can readily be retooled for work-piece changes. Be one of the first to explore this new idea . . . write Dept. TE-2 today.

Brief Specifications: Special Hi-reversal motor rated at 2 hp. Tap sizes to 1¼". Multiple heads can be mounted. Lead screw control for thread accuracy. Full electrical safety interlock against malfunction. Auto feed, clamp, eject. Self-contained coolant system.

TBD60

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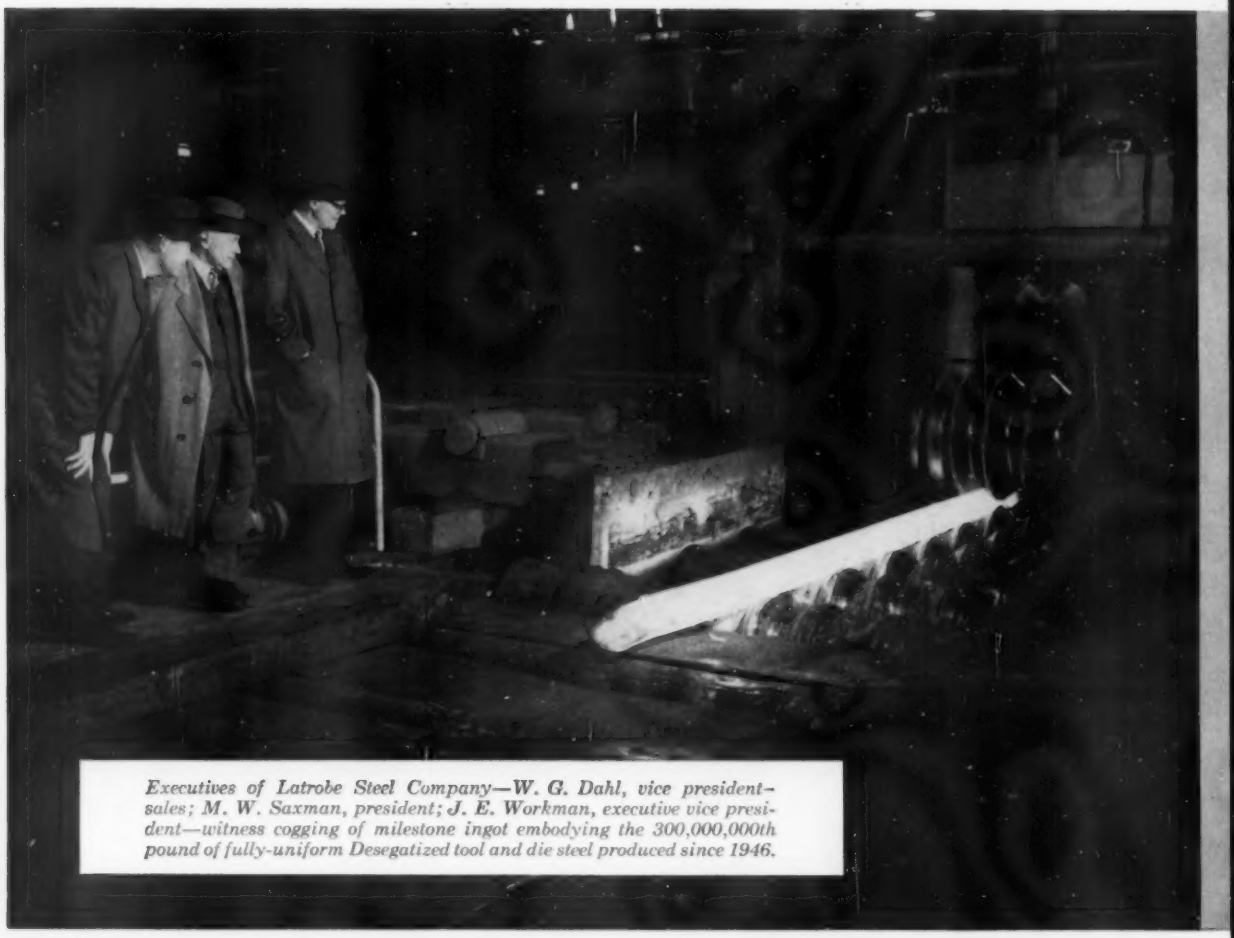

Executives of Latrobe Steel Company—W. G. Dahl, vice president–sales; M. W. Saxman, president; J. E. Workman, executive vice president—witness cogging of milestone ingot embodying the 300,000,000th pound of fully-uniform Desegatized tool and die steel produced since 1946.

300,000,000 lbs.

of fully-uniform

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TOOL and DIE STEELS

for Industrial America

Made in U.S.A. by skilled Metalmasters

14 years of pace-setting quality

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When first introduced in 1946, Latrobe's Desegatized process of manufacture involved new and revolutionary melting techniques. This process established new standards of quality in high speed steels and high alloy die steels. Here were steels fully uniform for the first time . . . no harmful carbide segregation . . . steels free from porosity . . . no weakening centerline inclusions!

Today, over 30 grades of Latrobe's tool and die steels are produced by the Desegatized process. These are available in regular analyses or XL and FM analyses containing properly distributed alloy sulphides for increased machinability. For manufacturers and users of cutting tools and metalworking dies, the full uniformity of Latrobe's Desegatized steels continues to mean extra toughness, greater wear resistance and reliable response to heat treatment.

Latrobe's research and development program continues. Not only will the metalworking industry benefit from better Latrobe tool and die steels, but the rigorous quality standards established through experience have been applied to the field of high strength and high temperature steels and alloys now produced for Space Age applications by Latrobe—Metalmasters for Industrial America.

Have a cutting tool, production die or specialty steel application problem? Call upon *experience* . . . Call Latrobe!

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Why Morse? Because other drill manufacturers threw up their hands at producing a drill to match the Thrustmaster's power. But Morse took on the job, applied a regular taper shank drill right off the shelf that more than meets the requirements of this exceptionally powerful machine.

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Look at these chips made during demonstration of the Thrustmaster.

Feed: .087" per revolution at 105 RPM

Drill: Regular Morse Taper Shank Drill (style 1302) driven in solid steel.

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February 1960

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LOOKING AHEAD

By T. W. Black
Senior Associate Editor

Industry leaders are almost universally optimistic about the growth of the American economy during this year and in the coming decade. Some of these predictions are of real interest to readers of this magazine.

George S. Eaton, executive vice president of the National Tool & Die Manufacturers Association, forecasts that the 1960 output of the contract tool and die industry will be 15 percent higher than 1959 production.

Extensive model changes planned by the automotive industry, plus new tooling for the office machine, electronics and household appliance fields are expected to contribute substantially to the upswing. The outlook for new tooling in the farm equipment and aircraft industries is not considered as good for 1960 as it was in 1959.

A year-end survey by the Drop Forging Association disclosed that forging industry executives anticipate substantial production gains in 1960. Some companies anticipate 25 percent gains.

Joseph H. Cadieux, president of Casting Engineers, Inc., says that sales of investment castings to nondefense industries should reach an all-time high in 1960. Until 1957, about 90 percent of all investment castings went into military hardware. Today, there is considerable demand for small investment castings in the manufacture of electronic equipment, machinery of all types, firearms and consumer end-use products.

The president of Kennametal Inc., Philip M. McKenna, notes that more products were produced with tungsten carbide cutting tools and cold working dies in 1959 than in any previous year. Part of this increase was due to the emphasis on obtaining high machine productivity, even at the cost of shorter tool life, he says. He predicts a further upswing in the use of carbide tooling in the 1960's.

Ford Motor Company economist George P. Hitchings states that the gross national product undoubtedly will surpass a $500 billion annual rate for the first time in 1960. Increased spending by business for new plants and equipment will be one of the factors keeping the GNP at high levels during the last half of the year.

Paralleling the expansion of the American economy, the electrical industry will double the output of electrical power during the next ten years, according to Westinghouse president Mark W. Cresap, Jr.

The machine tool and machinery segments of the economy will have a good year—much of the new business coming from an upswing in the mechanization of the country's productive plant, says Standard Pressed Steel Co. president H. Thomas Hallowell, Jr.

This Ex-Cell-O Bushing should outlast 2 of the kind you are now using . . .

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After drilling 16,300 test holes, the competitive bushing showed an average .0039" of wear—ready for scrap—while Ex-Cell-O bushings averaged only .0017" of wear, less than *half* as much!

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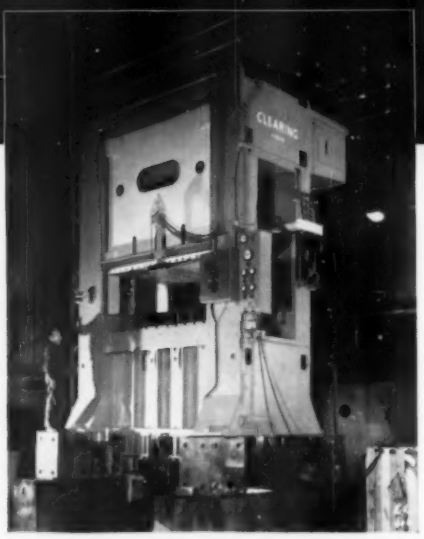

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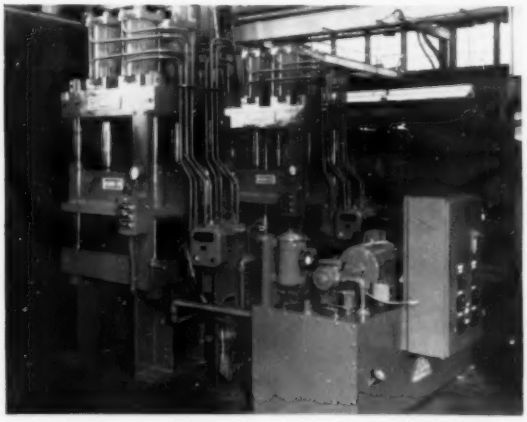
Sheet metal parts are drawn on this 750 ton press designed to handle off-center loads with blank and draw dies using individually controlled cushions.

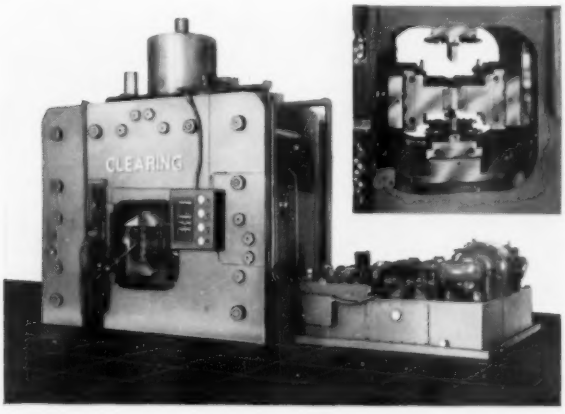


BOWLING BALLS—*MOLDING*

These two steam heated, 200 ton column-type hydraulic presses are designed for multiple cavity molding and operated from a single power source.

DIE CASTING—*TRIMMING*

High speed trimming is done on this 10 ton hydraulic gap press.



TITANIUM—*BRIQUETTING*

Four slides exerting 3,000 tons produce titanium briquettes. Inset shows 4 slide arrangement.

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